

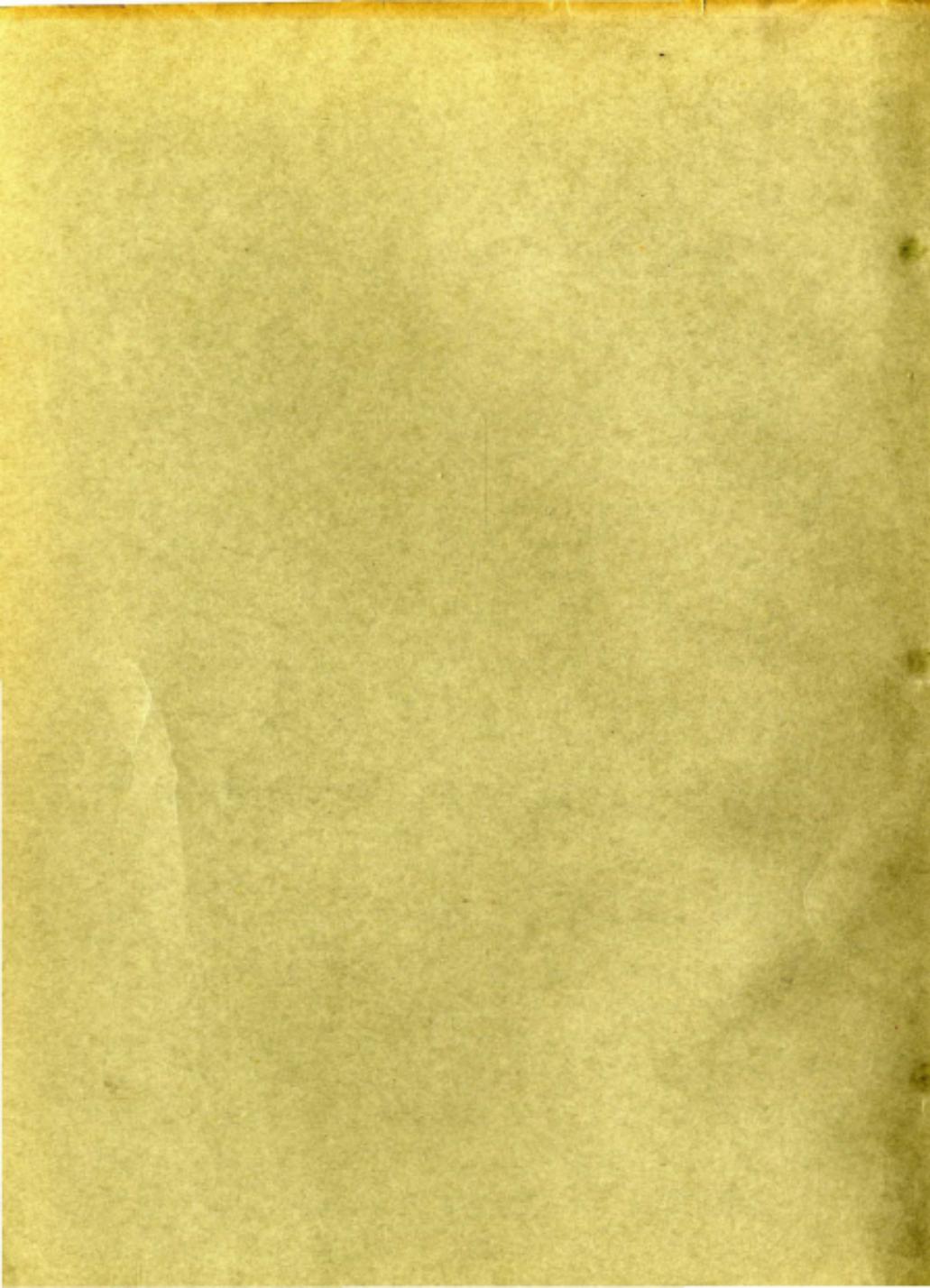
MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

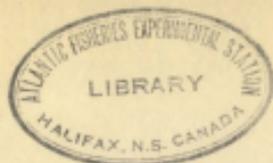
No. 131

Atlantic Salmon and Trout Investigations

Volume 14

1938





**FISHERIES RESEARCH BOARD
OF CANADA**

MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 131

Title

ATLANTIC SALMON AND TROUT INVESTIGATIONS, 1938

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ATLANTIC SALMON AND TROUT INVESTIGATION

VOLUME XIV

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ATLANTIC SALMON INVESTIGATIONS

1938

Report No. XII. Moser River Report,
1938

By Harold M. Rogers.

Moser River, N.S., is situated in the south east part of Halifax Co., and empties into the Atlantic Ocean through Necum Touch Bay, see Fig. 1.

The river proper empties quite abruptly into the upper end of an inlet which at high tide reaches an appreciable salinity; at low tide a great part of the bottom is laid bare and the water flowing out is almost completely fresh. So great is the influence of the salt water, that marine forms such as Zostera, Fucus and Mytilus are to be found almost as far as the head of the inlet.

The two-mile inlet is almost 200 yards wide at its narrowest point with a shallow expansion at the upper end; it widens considerably as it joins Necum Touch Bay. The greater part of this inlet is shallow with a luxuriant growth of eelgrass, but a narrow channel traverses it for almost its entire length, being quite evident at low tide when it is bordered by floating fronds of eelgrass. The accompanying chart (Fig. 2) will make the above description clear. Soundings are marked in feet and indicate approximate depths at ordinary low spring tides which are in the vicinity of 6 feet. At high water, the area of the inlet from the head of tide to Smith Cove is approximately $2/3$ of a square mile.

Water level.

Two hydrographs were set up at Moser River, one on the

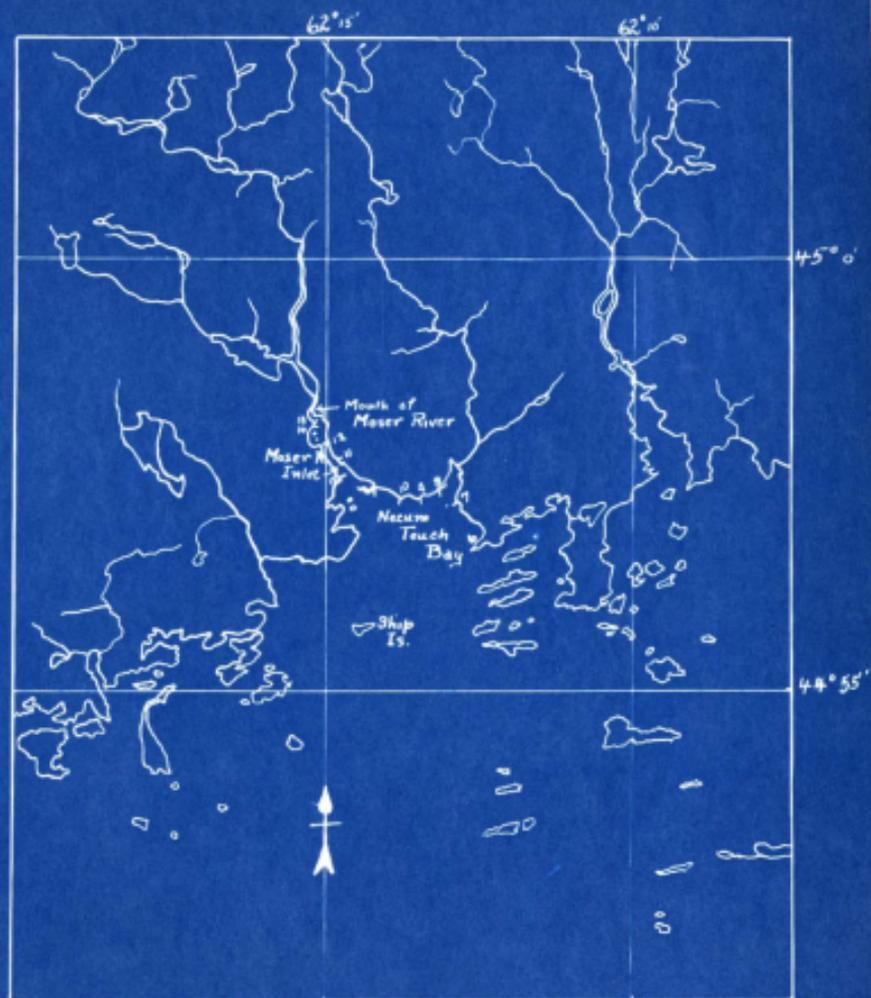
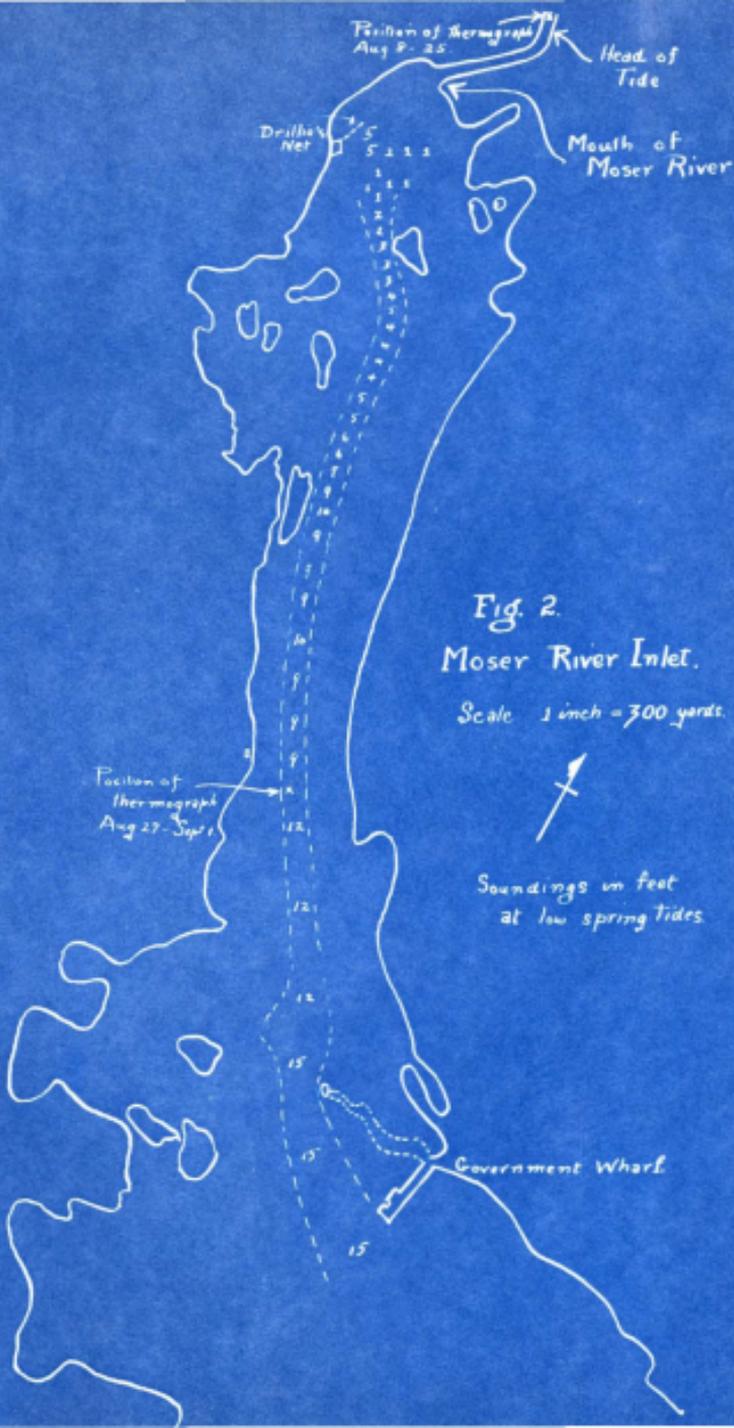


Fig 1 Vicinity of Moser River.



government wharf to measure the tidal amplitude, and the other on the river just above the head of tide to record any variation in the level of the river water.

The water level of the river for August and the first of September is recorded in Fig. 3, and at the point measured shows a maximum difference in level from the high of Aug. 11th to the low of Aug. 24th of 18 inches.

A heavy rain such as took place on Aug. 10th caused a very sudden increase in the level of the river which only gradually returned to its former state. The discharge at the peak of the Aug. 11th freshet was calculated to be approximately 450cu. feet per second as compared with the discharge of 100 cu. ft./sec. on the low of Aug. 23rd.

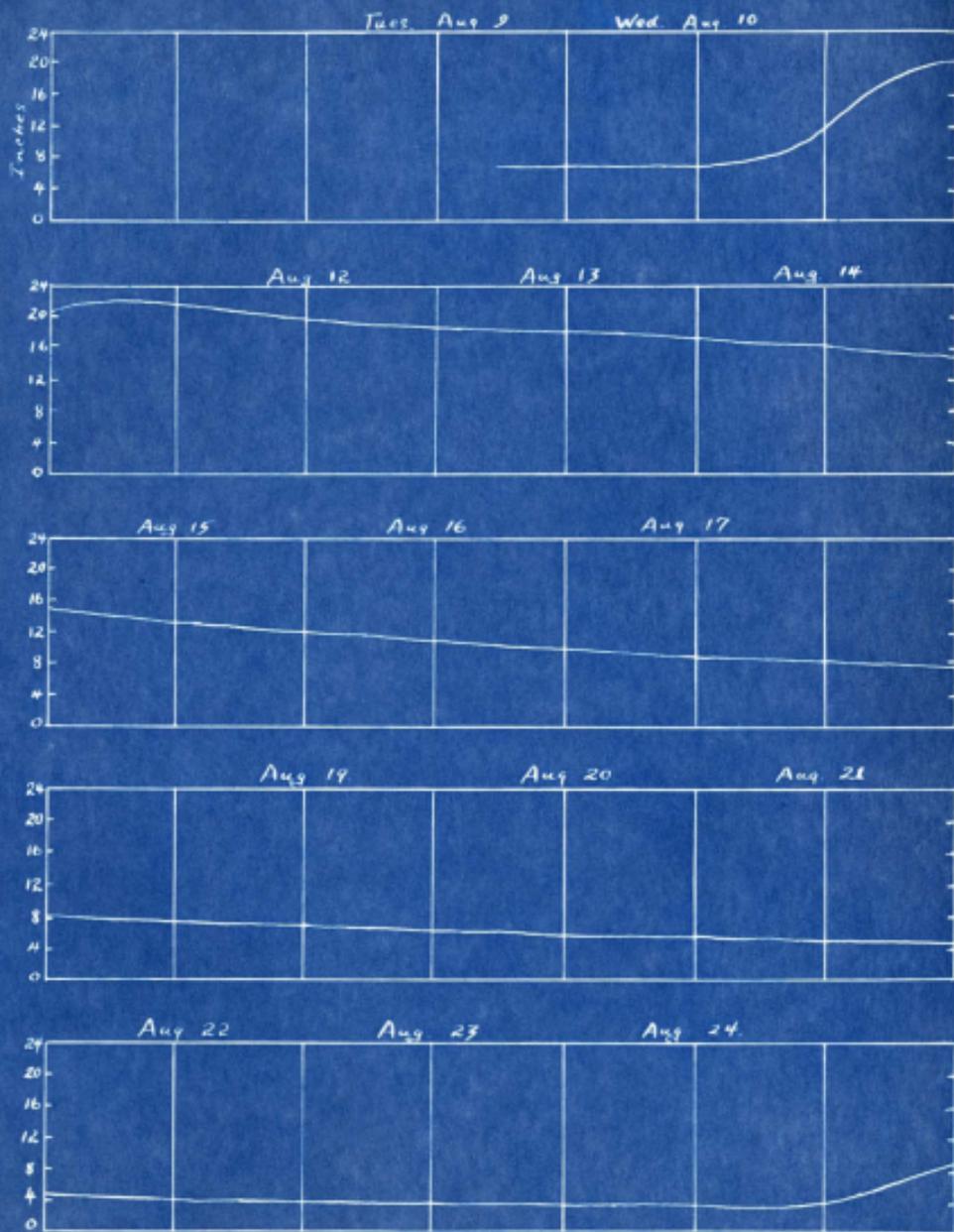
The Tidal curve, (Fig. 4) unlike that for Margaree was quite regular in its fluctuations. It showed a maximum difference in water level of 6' 4" for the spring tide of Aug. 25th, and a minimum fluctuation of 3' 0" which occurred during the neap tides of Aug. 20th.

A correlation may be seen between the tidal curve and the direction of the prevailing wind, southerly winds tending to drive ocean water inshore and so raise the general level of the water at all stages of the tide.

Rainfall.

During the month spent at Moser River, the rainfall was not as steady as during the three previous months. The weather was however dull, especially during the first half of the month. Two fairly heavy falls occurred, one of 1.83 inches on Aug. 10th causing a rise of 18 inches in the river, while

Fig. 3. Water Level Moser River at Head of Tide.



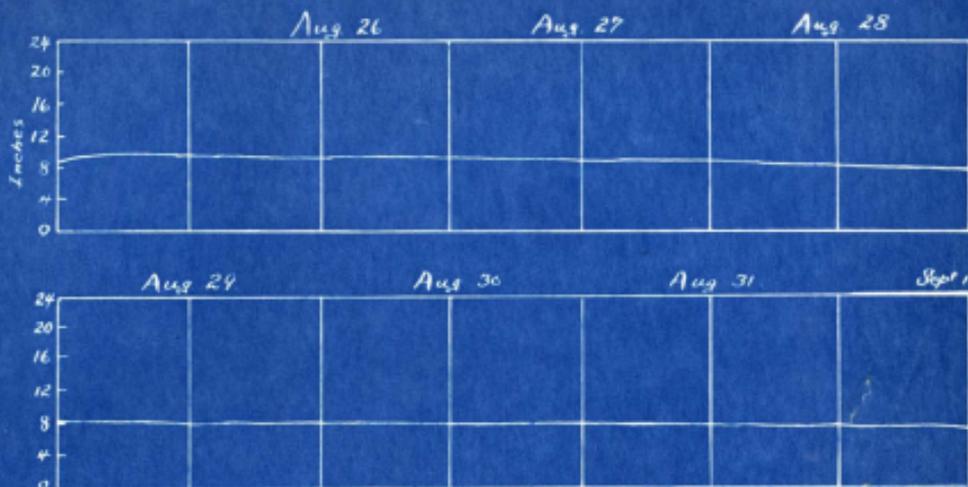
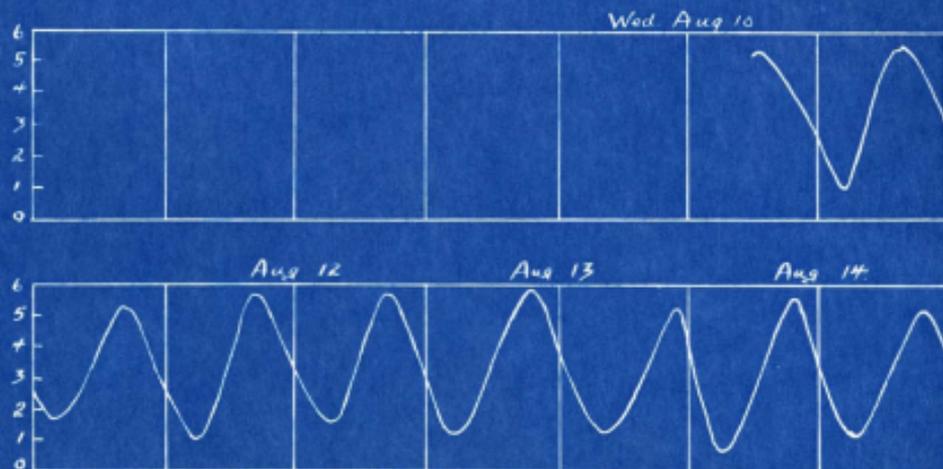
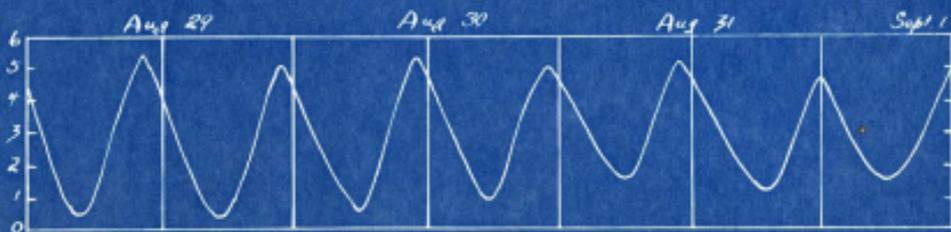
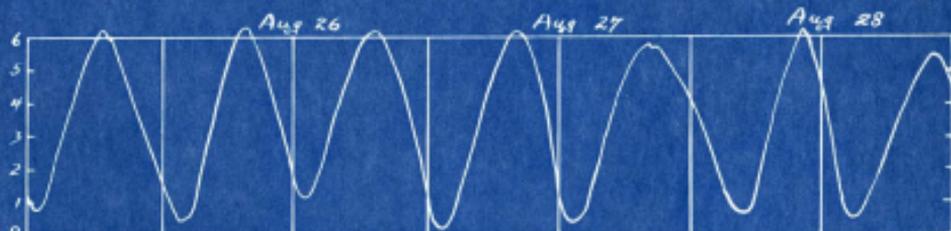
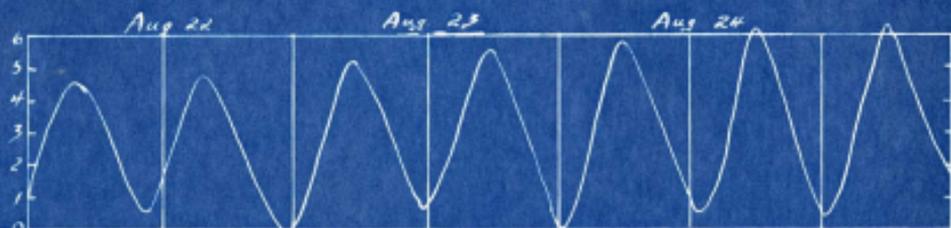
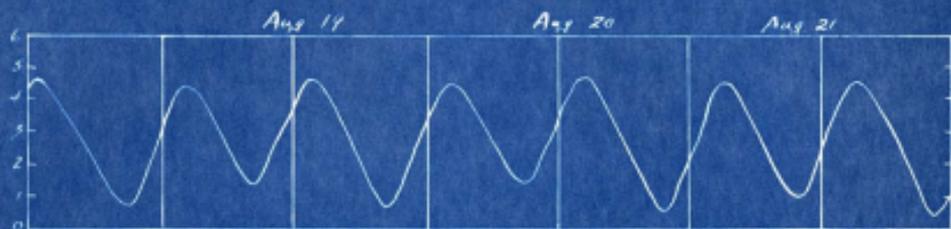
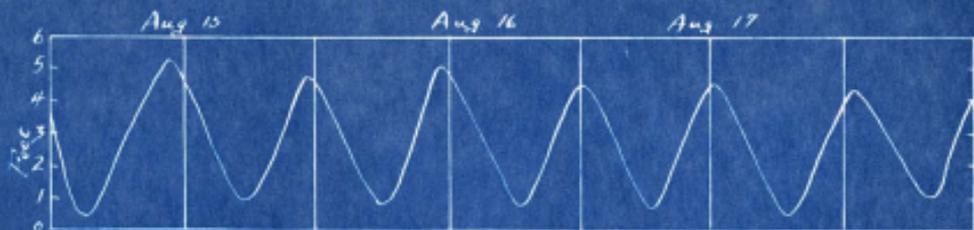


Fig 4 Tidal Amplitude - Government Wharf, Moser River.





on Aug. 25th, a fall of .835 inches brought the river up 6 inches. A drizzle that could not be measured in terms of inches of rain would at times occur, sometimes persisting for two or three days at a stretch.

Winds.

The prevailing winds during the month of August were from the south off the sea which probably accounted for the persistent wet weather. Winds from a northerly quarter occurred but rarely and never lasted for any length of time. Most surveys concerning the direction and extent to which fresh water extended out to sea were carried on when the wind was from a southerly direction, but near the end of the month, a survey was finally accomplished with the wind from the opposite quarter, revealing a totally different set of conditions.

Water Temperature.

A thermograph was used to record the temperature of the river water, the machine being placed under the highway bridge just above the head of tide on Aug. 8th. On August 25th it was placed on a raft anchored in the inlet opposite the property of George Moser and for a short time the water on the surface and at a depth of five feet was tested.

The records (Fig. 5) show that the river water is quite warm, 63°F. being the lowest recorded with the highest at 83°. On several occasions the temperature rose above 80°F.

The curve seems to be dependent mainly upon the amount of sunlight, an overcast sky being accompanied by a comparatively low water temperature, while on a sunny day, a considerable increase in temperature was noted, the time of highest

Fig. 5 Water Temperature, Moser River at Head of Tide

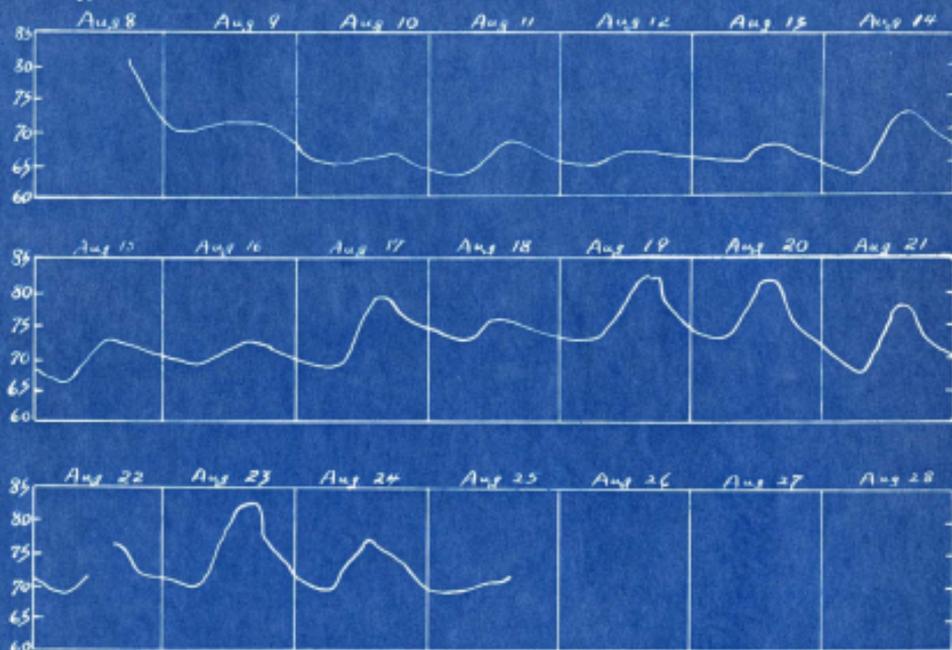
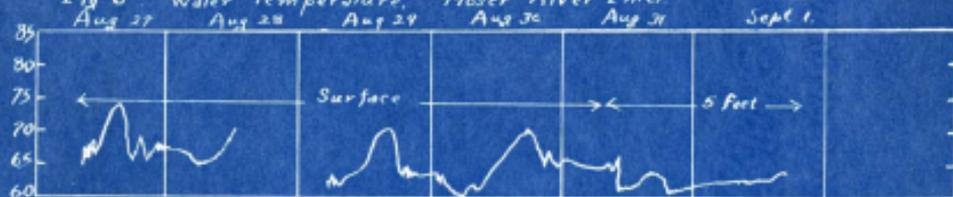


Fig. 6 Water Temperature, Moser River Inlet



temperature being between 1 and 4 in the afternoon.

When placed on a raft in the inlet on Aug. 27th, (position marked in Fig. 2) the thermograph revealed as expected a temperature lower than that of the river, with the water at a depth of five feet being cooler than that at the surface and less subject to variation. (See Fig. 6)

Penetration of Salt Water Up River.

In testing for the salinity of the water, the drop method used in previous years was employed in order that the approximate salinity might be known immediately without the necessity of recourse to laboratory titration.

During high spring tides, the effect of high water is felt almost as far as the highway bridge which is some three hundred yards above the entrance of the river into the inlet (See Fig. 2). During neaps, the high tide does not extend much farther than the mouth of the river.

Although salt water progresses up the inlet on the rising tide for a considerable way, it does not penetrate quite as far as the limit of tidal influence, being prevented from so doing by the river water which is backed up by the incoming salt water. Salt water as high as 28‰ on the surface reaches as far as the group of small islands at the upper end of the inlet before it undergoes dilution which takes place rather abruptly in the next few hundred yards. It is in this region that the Zostera and Fucus become scattered in their distribution and dwarfed in appearance.

Bottom water of a salinity of 25‰ was found in the last deep hole at the upper end of the inlet.

Direction and extent of flow of Moser River water into the sea.

Seven surveys, six by rowboat and one by motorboat were made to ascertain the fate of the Moser River water on leaving the inlet. With one exception, all were made with the wind from a southerly quarter which was the direction of the prevailing wind for the summer. The last survey was made with a North East wind, and the results obtained were sufficient to indicate that the direction of flow of fresh water from the river is dependent primarily on the direction of the wind.

The outflowing fresh water is confined at first to a narrow layer on the surface which gradually deepens as the water becomes diluted. In the Inlet, the layer was between 1½ and 2 feet in thickness, increasing to about 6 feet with dilution in Necum Touch Bay proper. The following table illustrates the order of salinity change:

<u>Moser River Inlet ½ ebb</u>		<u>"Outside" between Ship Is. and Mainland.</u>	
0 feet	5%	0 feet	26%
1 "	6%	1 "	27%
2 "	27%	3 "	28%
3 "	28%	6 "	31%
9 "	28%	12 "	31%

The data obtained may well be condensed graphically to two charts, Figs. 7 and 8, illustrating the effect on the outflow of fresh water of the two opposite winds.

With the southerly winds which prevailed most of the time, the direction of flow of fresh water as seen by Fig. 7 is to the east past Smith Cove. With the wind from the opposite quarter as occurred on Aug. 30th, the tongue of fresh water can be seen progressing to the south west between Ship Island and the mainland. In this figure (Fig. 8)

the insert shows the isochalines down to five feet for the stretch of water between Ship Island and the mainland. They indicate that the fresh water influence decreases with depth as one approaches the island from the mainland.

The insert in Fig. 7 concerns the stretch of water between Government Wharf and the opposite shore of the inlet. The influence of the fresh water which if forced by the wind to the north-east side of the inlet is felt to a greater depth than on the south west side.

In both cases, the tongue of fresh water was followed only about $1\frac{1}{2}$ miles outside the government wharf. In the case of the north east wind, a minimum salinity of 24‰ was found at the farthest point reached (between Ship Island and the mainland), while a salinity of 25‰ was recorded from the other side of Necum Teuch Bay to the south-east of Smith Cove with a south westerly wind.

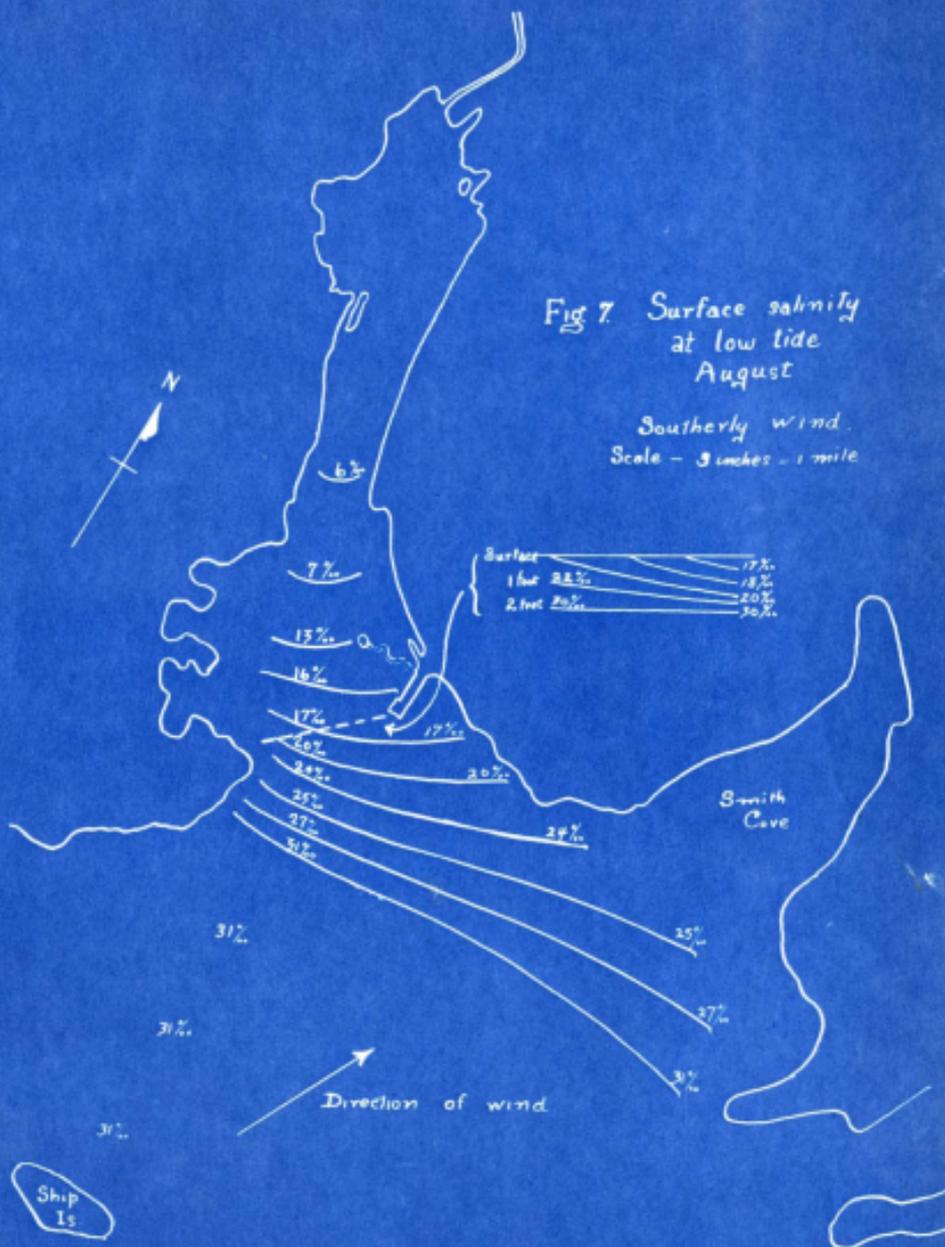
Flora and Fauna.

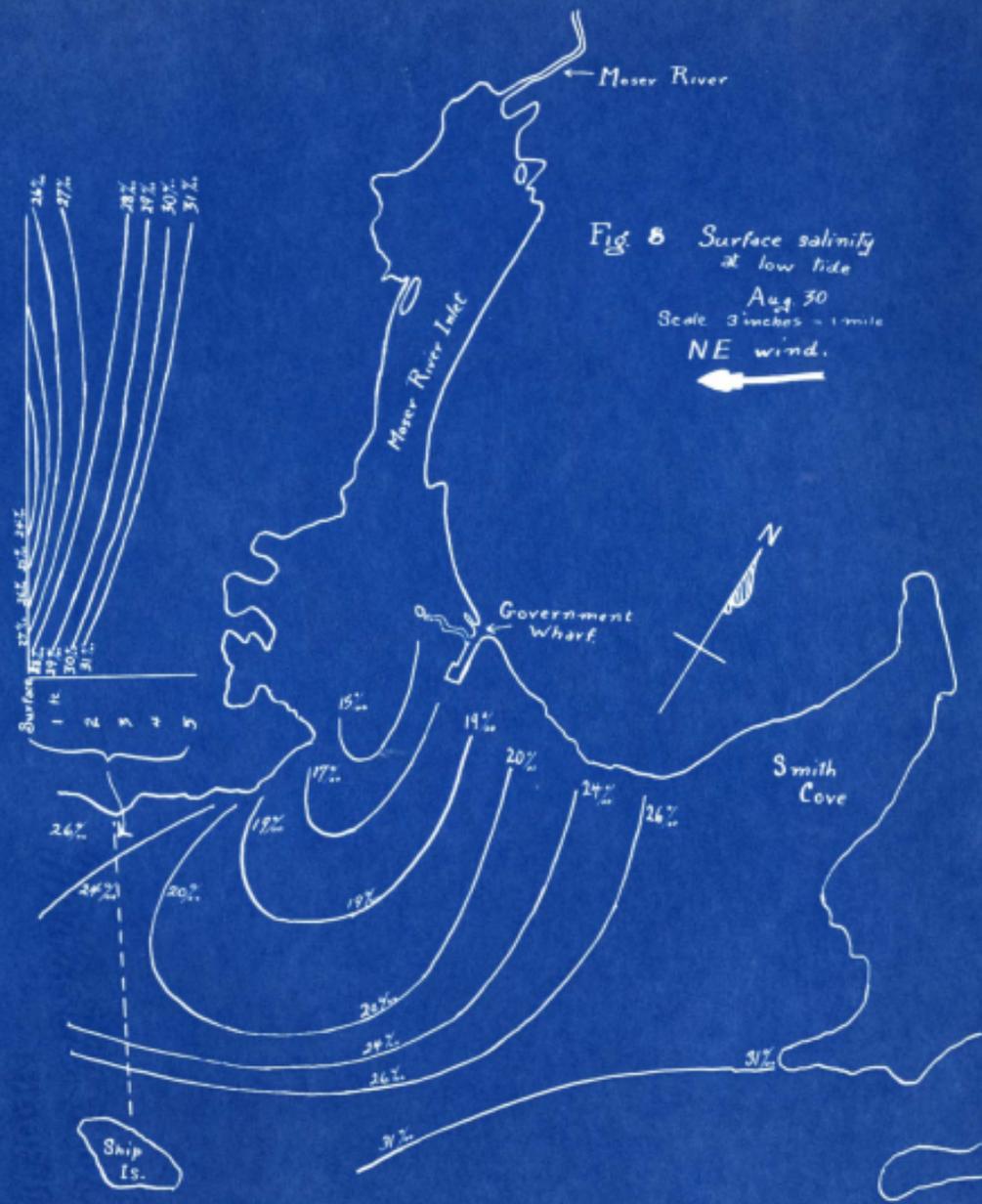
The flora of Necum Teuch Bay consists almost entirely of two plants, Zostera and Fucus. The eelgrass is by far the more extensive, covering large areas of flats and extending from just above the low tide mark to the edge of the narrow channel which at low tide is very clearly defined by the margin of the Zostera areas. It extends up the inlet almost to the mouth of the river proper.

The eelgrass is rapidly regaining its former foothold, several local people reporting it to be more abundant

Fig 7 Surface salinity
at low tide
August

Southerly wind.
Scale - 3 inches = 1 mile





this year than last. There is indeed no lack of it, a fact that can readily be verified at low water. Among its leaves may be found a great many animals of various species.

Fucus is confined mainly to the tidal zone, it apparently being prevented by the *Zostera* from extending farther from shore. It likewise extends up the inlet nearly as far as the mouth of the river proper, although both species are much more scattered in their distribution at the upper end than they are over the main part of the bay.

Enteromorpha, though present, is not at all abundant.

The fauna of the bay is comparatively rich. Among the eelgrass are to be found large numbers of Micthelmysis stenclepis. Eelgrass has been noted to be the favorite (sic) habitat of this mysid in other estuaries. Other crustaceans present include Crago septemspinosis, Gammarus locusta, Jasra marina and Corophium cylindricum. Considerable numbers of the crab Cancer irroratus were present, and the shells of dead specimens littered the shoreline everywhere.

Molluscs were also very numerous in the bay and inlet, especially Mytilus edulis, though many were of a very small size. Mya arenaria, Macoma balthica Blynices heros, and Venus mercenaria were also to be readily found. Littorina rudis was present in the inlet but was not as prevalent as it would probably have been had the bottom been of a more rocky nature. It was replaced by L. litorea farther out the bay.

The only annelid readily noted in the inlet was Nereis diversicolor.

Among the coelenterates, both Aurelia flavidula, and Cyanea arctica were occasional visitors. Large masses of Obelia were to be seen growing in certain areas.

No living echinoderms were observed in the inner parts of Necum Touch Bay, although the empty cases of the sea-urchin Strongylocentrotus drobaehienseis were a common sight along the shore line.

Fish

The salmon is the important fish in the Moser River, the main run being in the spring during May and June. Unlike that of the Margaree, the Moser River run is made up largely of grilse, locally termed "jumpers", with which, so it is said, the river abounds during a good year. The run was very poor during 1938.

Smelts are quite common in the spring and fall of the year, but as far as could be ascertained from the populace, they do not ascend the Moser River itself, though they do enter what is hardly more than a ditch a short distance from the mouth of the Moser River proper. Considerable numbers ascend Smith Creek which empties into Smith Cove, and they also ascend Moosehead brook some two miles along the coast to the west.

Gaspereaux are common, the river being so full of them in the spring that many are literally lifted bodily out of the water by the pressure of those behind and beneath. Many die when the river falls to a low level, natives declaring that in so doing they pollute the river. In the late summer

the young leave the rivers and brooks and are to be seen in large numbers frequenting the shoreline and shallow areas.

The eel is frequently seen and the stickleback Gasterosteus aculeatus is present in large numbers. Among the eelgrass was found the young of Cyclopterus lumpus.

Birds.

Gulls, terns, cormorants, blue herons and king fishers are all to be seen around Necum Teuch Bay.

Reports of Salmon Fishermen.

Very few fish were taken in the nets this year in Necum Teuch Bay. The berths usually fished are indicated by numbers in Fig. 1, but in 1938, only Nos. 6, 8, 13 and 14 were set out.

William L. Smith who set out No. 6 at Mitchill Point reported that he got only eight fish. The run of salmon is early in Moser River and he did not set until it was nearly all over, his net being out from the last of June into July, a period of two weeks. He reported that fishing was bad this year and that he did not lose much by not setting earlier. From his observations over a number of years, he has come to the conclusion that there is a three year cycle, with the present season in the pit of the curve of abundance.

William G. Smith aged 79 years, had his net (No. 8) out for about one month, catching 14 fish only. He also reported a very bad season, not making expenses. Last season was good.

Raymon Drillio who set Net No. 13 from about the middle of May until the last of June said that he took 20

fish, a very poor catch. He usually gets a large return due to the position of his net, (See Fig. 2) but this year was bad. He reported that net No. 14 could not be kept out because of the interference of the pulpwood which covers a considerable area in the upper part of the inlet. Considerable dissatisfaction has been voiced at the way in which certain pulpwood operations are carried out.

Several individuals around the river complained of the bark which was being dumped into the water from the pulpwood operations. Raymond Drillie said that in places, it had accumulated to a depth of three or four feet. Whether this has any undesirable effect upon the salmon is an open question, but it would seem probable that, due to the diurnal renewal of water in the bay, there would be very little if any deleterious effect upon salmon outside the river proper. In the river, the matter is somewhat different, and would become a point for consideration if the peelings were deposited upon the spawning grounds.

It was noted that after a boom of pulpwood was floated away from an area where it had been anchored for two weeks, the eelgrass which had been there originally was dead. During those two weeks, light was cut off from the Zostera.

Many complained also of the low water which prevented salmon and grilse from ascending the river, and wondered if something could not be done in the way of water control to ensure an adequate flow of water all summer long. Many fish became trapped^P in pools without an outlet to finally die either from the heat and lack of oxygen or by human depredation. The skin of these fish is reported to turn a very dark hue, almost jet black in some cases, and the flesh to lose its

pinkish tint, the colorless tissue assuming an insipid flavour.

Many thousands of gaspereaux die in this manner also.

There was apparently no disease affecting these fish such as was noted the last few years with the gaspereaux on the Margaree River.

WEATHER, MOSER RIVER, AUGUST 1930

Date	A.M.				P.M.			
	AirTemp °C	Sky	Wind	Rain	AirTemp	Sky	Wind	Rain
8								
9	19.4	10	SE 2	-	25.6	0	NW 1	-
10	16.2	10		1.83	16.9	Shower rain	E 2	.107
11		2	E 2	.006		10	SE 1	-
12	19.4	10	SE 1	-	19.6	rain	SE 1	.20
13	23.9	mist	NW 1	.048	22	9	SE 1	.545
14		0	S 1	-	26.4	0	S 1	-
15	21.5	2	SE 2	-		3		-
16				-	23	2	SW 3	-
17	23.8	1	SE 1	-	28	1	SSW 2	-
18	23.7	1	SSW 1	.095	25.2	10	SSW 1	-
19	24.3	1	0	-	23	7	SE 1	.193
20	24	2	NW 1	-	26	3	NW 2	-
21	20	2	S 2	-	23	3	S 2	-
22	22	10	WSW 2	-	22	6	WSW 2	-
23	21	3	WSW 1	.198		4	SW 2	-
24	22	7	SSW 2	-		5	SSW 2	-
25	19.3	10	SW 2	.835	21.5	7	SW 1	-
26	20	8	N 3	-	19.3	9	SW 1	.09
27		1	0	-	21.5	1	WSW 3	-
28		0	SW 1	-	wars	clear	SW 2	-
29	18	0	0	-				-
30	17	0	SE 1	-	20	2	SE 1	-
31	21	0	N 3	.09	24	2	N 1	-

ATLANTIC SALMON AND TROUT INVESTIGATIONS

1938

Report No. XIII. Winter Food of the Mergansers on the Margaree River.

By H. C. White

Residents along the Northeast Margaree river have reported that every year mergansers winter on the river and feed wherever there is open water. They will alight upon small areas of open water and dive beneath the ice in search of their food. During very cold weather when there are few open places in the river ice, the mergansers feed in the smaller spring-fed brooks which do not freeze.

Forest Glen brook is partly spring-fed and remains open relatively more than the river. Since complete protection of the fish of this brook is desired until the final count of the smolts for the bird-control experiment, a guardian has been appointed to keep the mergansers under control throughout the winter. This guardian has reported that the mergansers are scarce this winter (1937-38). This may be, in part, due to the killing of a considerable number there during the past summer. This winter the Department of Fisheries also has maintained a guardian patrol on the river and tributaries in the Frizzleton region some seven miles below Forest Glen brook. According to a recent letter from Inspector Murphy, this guardian has killed a considerable number of mergansers. He reports that in one week he had killed seventeen, ten of which were on Hatchery brook. Undoubtedly the destruction of these ducks has been a factor in reducing the number of ducks visiting the river

above this area.

The guardian at Forest Glen brook has killed a number of ducks but owing to the difficulty of securing them from the open portions of the river before they are carried beneath the ice by the current, up to the end of February, he has been able to secure only four of the ducks which he has killed.

We have received the stomachs of these and also the bills to aid in identification of the species. These were all American mergansers and were shot within a few rods of the mouth of Forest Glen brook. The analyses of the food in their stomachs^h have been completed and the results are given in the accompanying table.

These four ducks contained the remains of twenty-four salmon parr. From bone comparisons it has been judged that eight of these parr were of the sizes of first winter parr, ten were in their second winter and six in their third. The large proportion of the second and third winter sizes found in these stomachs would seem to indicate some form of selection.

From residents along the river we have heard numerous reports of the finding of large numbers of salmon parr in mergansers shot during the winter. The usual story is that having shot a merganser it was picked up by the legs and a number of parr fell from the duck's mouth upon the ice or snow. We have repeatedly noticed the ease with which the ingested fish fall from the gullet of a freshly killed merganser and this with the results of the recent analyses make us believe that, allowing for exaggerated numbers, a fairly common fault, the reported observations of the residents are true.

American Mergansers Shot on Upper Margaree River, January 1938.

Date	Place	Salmon			Remarks
		1-w. size	2-w. size	3-w. size	
<hr/>					
Jan.					
1	Mouth of Forest Glen Brook	6	8		
14	"	-	-	-	salmonid bones
22	Slide pool	-	1	-	
29	"	2	4	3	
		<hr/>	<hr/>	<hr/>	
		8	13	3	

ATLANTIC SALMON AND TROUT INVESTIGATION

1938

Report No. XIV. Fish-eating Bird Control Experiment on
Forest Glen Brook in 1937

By H. C. White.

In 1935 investigations were commenced on the relation of fish-eating birds to the salmon and trout of the Margaree river and in 1936 these investigations were continued. The results of the finds have in part been published (White, 1936, 1937). These studies have shown that in general mergansers and king-fishers feed upon those fishes which are most available upon their feeding grounds. On the Northeast Margaree where salmon (Salmo salar) and trout (Salvelinus fontinalis) are the dominant fishes, birds consume annually large numbers of the young of these fishes. It is thus desirable to know whether or not the destruction of these fishes by birds constitutes a real economic loss to the commercial and angling interests.

If we accept as a premise that an increase in the number of smolts reaching the sea will result in an increase in the number of mature salmon, then any factor affecting the numbers of smolts will also affect the numbers of salmon maturing from the smolts. Since a large part of the young salmon which are eaten by the birds have quite or nearly completed their river growth the killing of these is comparable to the killing of a like number of smolts.

Investigations on the Margaree river system have shown that in the waters in the immediate vicinity of human habitations or near well-travelled highways where fish-eating birds are frightened

away, young salmon in all the advanced stages are more abundant than they are in similar waters in other parts.

All streams tributary to the Northeast Margaree were closed to angling for a number of years but at the end of the closed period there was no evidence of any increase either in young salmon or trout. During this closed period fish-eating birds were allowed to breed and feed almost unmolested along these tributaries.

Forest Glen brook, a tributary of the Northeast Margaree entering the river near the head of settlement, was one of the streams which was closed to angling. On July 6, 1936, the last year of the closed period we went up this stream for a short distance and saw a flock of about a dozen young mergansers with the female and we were told at that time by the local warden that there had been flocks several miles farther up the stream. We observed also kingfishers feeding along the stream. On August 4th accompanied by Dr. A. G. Huntsman a survey of the stream was made along some five miles of its length. Our methods of survey consisted of direct observations into the pools and other parts of the stream, angling with small artificial flies and seining with a small fine-meshed seine. By direct observation, although visibility was good, the only place where any salmon or trout yearlings or older fish were seen was in the pool beneath the highway bridge. Our angling along several miles of the stream yielded only four fish. The use of the seine verified our other methods as hours were required to collect a few salmon and trout for specimens. These were found beneath the stones in the swifter

parts of the stream. However, there was an abundance of both salmon and trout fry-of-the-year which at this time were probably too small to attract fish-eating birds.

During the survey of the stream we found no fish-eating birds along the stream or any manure splashes on the stones or beneath the perches to indicate that they had fed there recently. It appeared that this stream represented one on which the birds had fed until the fish population had been reduced until the stream was no longer attractive to the birds as a feeding area.

The Experiment

Having chosen this stream as an example of one on which the fish-eating birds had fed unmolesated, it was proposed to determine its productivity of smolts under these conditions and then to keep the birds under control for one or more years and determine each year the seaward run of smolts from the stream. By this experiment we hope to find the effect of bird predation on smolt production.

The trap

This past year (1937) we arrived at Forest Glen brook on April 13 well in advance of the smolt run and at once began the construction of a barrier and trap to intercept and catch the descending smolts.

The barrier consisted of a heavily balasted framework of logs which supported a slat rack with half inch spaces between the slats. The wings of the barrier reached from the bank to the centre of the stream in a V-form with the apex downstream. A rectangular slat trap with the conventional V-shaped lead was placed below an opening at the apex of the barrier. The trap

was lined with fine-meshed screen to lessen the danger of the trapped smolts becoming injured. All spaces below the barrier and trap were first filled with stones of various sizes and then a layer of gravel to insure that none of the smolts would escape beneath the structure.

Descent of the smolts

Although the trap was in fishing order by April 24, no smolts were taken in it until May 15 when the first one was captured. Between May 15 and 22, only seven smolts were taken. On May 23, the first small run occurred and twenty-six smolts entered the trap. The run increased until the first of June after which there was a falling off in the general run although on June 4 the largest single catch was made. On that date three hundred and thirty-three were taken and on the following day two hundred and five. After this run there was a sharp decline with only a small number being taken up to July 7 when the run ended. A total of 1834 smolts was taken in the trap.

Factors influencing the run

During our observations on the smolt run at Apple river, N.S. in 1934, we found that the peaks in the run were coincident with rainy dark nights when there was a rise, even though small, in the water level. At Forest Glen brook there was a similar correlation between the run and dark rainy nights but during the first part of the run this was not well connected with any noticeable rise in the water level. The head waters of this stream are situated in tablelands where snow remains until well into June and as the uplands become drained the stream level falls gradually.

This general dropping in the water level was occurring during the first half of the smolt run, and although the peaks in the run were correlated with rain the amount of rain-water was at times not sufficient to equal the general decline in the discharge. This fact seems to preclude an actual rise in the stream level as a factor but the run may be influenced by the presence of rain-water and the lessened light. During the latter part of the run when the tablelands were mostly drained of surplus water the rains caused rises in the water levels and these are definitely correlated with the increases in the numbers of smolts taken in the trap. In general it was found that the best runs occurred on mild dark rainy nights. In figure 1, we have plotted the smolt runs and water heights and also the days on which rain occurred.

Ages and lengths

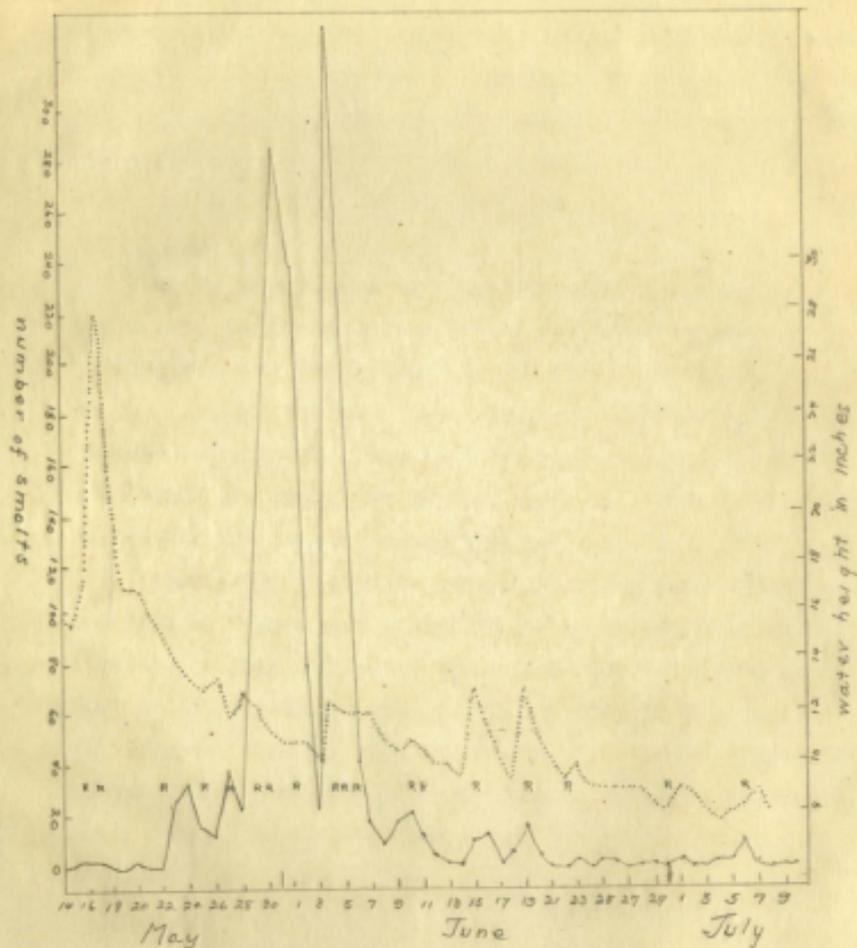
Throughout the smolt run, random samples were taken from the catch and each was measured and scale samples were saved. The smolts ranged from 110 to 167 mm. and averaged 135mm. Scale readings have been made of two hundred and eleven of the scale samples. Seventy-seven per cent of these had spent three winters in the stream, twenty per cent two winters and two per cent four winters.

Before being liberated each captured smolt was marked with a cross on the left side. This mark was made by removing the scales with a narrow sharp chisel-like instrument. This operation also injured the scale pockets. Former markings in this manner have shown that the regenerated scales form a pearly scar which may be readily recognized when the smolt becomes an adult salmon.

Bird Control

In accordance with the plans of the experiment the destruction

Figure 1 showing the relation of smolt run to water height and rain. Solid line shows numbers of smolts, dotted line water height and "R" rain.



or the frightening away of fish-eating birds in the vicinity of Forest Glen brook was begun as soon as possible after our arrival there on April 12. At this time all the ice had not as yet disappeared from the brook and along parts of either side there was ice up to two feet or more in thickness but the centre of the stream was open. In the woods bordering the stream there was deep snow. The ice and snow conditions made any extensive patrol of the brook impossible for the first ten days.

Mergansers

During this time we saw several pairs of mergansers flying up or down the brook and on several occasions we observed them feeding along the river below the mouth of the brook. Residents of the district reported that mergansers had been on the river through the winter. Since in other years mergansers were said to nest along the upper part of the brook, it was desired this year to destroy the females before they had nested.

Three breeding females were shot on the brook before nesting and several others were killed on the river near the mouth of the brook. Although the latter were not on the brook they might have used it as a feeding ground for their young if they had been allowed to bring out broods. Apparently as a consequence of these killings no young ducks were seen on the brook throughout the summer. No other mergansers visited this stream until late in the fall when a few were driven out.

Kingfishers

The first kingfisher was seen along the brook on April 26, but one had been heard flying over a week before. At this time conditions in the stream were not very suitable for the feeding

of kingfishers. The water for the most part was high and the only young salmon which we could find were beneath stones on the rapids but in the small intervale spring-fed brooklets the water was clear and there was an abundance of small trout visible at all times. During the summer these little streams are largely hidden in the alders and are not visited by the kingfishers excepting during high water periods but at this time, with the alders not yet in leaf they afforded good feeding grounds. Kingfishers were first observed feeding in the intervale spring waters where salmon seldom occur and pellets picked up early in the season consisted largely of trout bones. It appeared that the presence of these spring areas made it possible for the kingfishers to take possession of the adjacent nesting areas early in the season.

The first partly completed nesting burrow was found up Forest Glen brook on May 5. When found the nests were destroyed and the nesting birds killed but almost at once other kingfishers came in to occupy the territory. On July 19, a female containing maturing ova was captured in a new burrow. This was the latest record we secured for attempts at nesting. After this no kingfishers were seen along the stream until the first week in August when a migration of young birds from other parts began. We have referred to such migrations in a previous paper (White 1936).

Along Forest Glen brook and the neighbouring parts of the Margaree we had destroyed nests containing twenty-two eggs and thirty-four nestlings and yet during August and September, seventy-three kingfishers, mostly juveniles, were shot on the brook. During late August and September the local warden trapped forty kingfishers within half a mile of the brook. This destruction of kingfishers in the vicinity of Forest Glen brook apparently

did not materially decrease the kingfisher population on other parts of the Margaree.

Great blue herons

Great blue herons were not found along Forest Glen Brook until after the breeding season and then only juveniles were seen. Eight were shot along the brook and one about a mile below the mouth of the brook. At no time did they appear to be a menace to the fish of the stream.

Other fish-eating birds

During the summer the only fish-eating birds other than kingfishers, mergansers and herons observed along the brook were one American bittern, a juvenile, and one osprey. Both of these were shot.

Effect of bird control

On August 4, 1936, during a preliminary survey of the stream, which we have previously described, it was found that after uncontrolled feeding of the birds few young salmon or trout, other than fry, were to be found in the stream. In order to find out whether or not the control of the birds had resulted in any increase in the numbers of the more advanced salmon and trout, a second survey was made on August 4, 1937.

Weather and stream conditions were very like those of the same date of the previous year and the procedure of the second survey was carried out to duplicate as nearly as possible that of the first survey. Our methods were again direct observation, angling and seining.

No salmon or trout larger than fry were observed in the pools in 1936 but during the survey of 1937 both salmon and trout fingerlings were seen to be abundant in all the pools.

In 1936 four fish only were taken by angling along several miles of the stream. In marked contrast to this, in 1937 young salmon and trout could be caught, on the small artificial flies, in numbers from the pools and rapids of the stream.

Again the seining confirmed our other methods and large numbers could readily be taken by this means.

On the entire Margaree system the only other places where we observed salmon parr in such concentrations were along those portions of streams near human habitations or well-travelled highways where fish-eating birds were kept away.

Whether or not this increase in parr will result in an increased smolt run can only be determined by further trapping of the descending smolts.

Methods of bird control

If it proves desirable to keep under control the number of fish-eating birds which feed upon young salmon and trout in our open waters it will become necessary to study methods which are most effective in reducing their numbers along these waters. The methods employed will depend largely upon the species of birds and the character of the water areas which it is desired to protect.

In fish-cultural establishments many sorts of devices for screening the rearing ponds or for frightening birds have been employed with various measures of success. However, in the open waters any type of screening would appear impracticable and the general effectiveness of "scarecrows" is not known. In our experiment at Forbes creek, P.E.I. in 1930 we used red flags conspicuously displayed at intervals over the stream and these were effective for a month or more until some of the birds

became accustomed to them. If screening or attempts at scaring the birds are ineffective it then seems that the only alternative is the destruction of the birds which frequent the waters where protection is desired.

Kingfishers

Kingfishers are undoubtedly most effectively kept under control by the use of pole-traps. When employing this method small steel traps, generally No. 0 or 1, are set on the tops of poles which are placed upright along or in the waters which are to be protected. We have seen these used effectively around rearing ponds and they have been used with considerable success by one of the wardens along the Margaree river. The objections raised by certain conservationists and others against the use of these traps are that they are not selective but take birds other than kingfishers and also that when the birds are caught by the feet they are allowed to suffer. Both of these faults may be remedied by proper arrangement of the traps.

At Forest Glen brook we arranged a number of perches for kingfishers to alight upon and we shot kingfishers which were on them. We observed many using them but at no time did we see any bird other than a kingfisher alight upon them. Traps set upon such perches would take a minimum of other birds. The tops of these perches were about four feet above the water and thirty feet or more from the bank of the stream. In smaller streams where perches could not be placed as far from the bank there would probably be a greater likelihood of other birds using the perches.

It is not necessary to allow the trapped kingfishers to suffer. If the traps are placed over the water and are fastened to the

perch with a chain or wire extension long enough to allow the sprung trap to fall into the water the trapped birds will drown soon after being caught.

Destruction of the kingfishers' nests and the killing of the nesting birds was undertaken in the neighbourhood of Forest Glen brook. On two occasions the female birds were killed; at one site the male only was killed and at another both male and female were killed and yet in every case nesting operations in the immediate vicinity were only temporarily interrupted. When the nest only was destroyed a new nest was started within a day, a few feet from the site of the old nest. These observations would indicate that, in those areas, there was a scarcity of nesting sites. New attempts were made to occupy one nesting territory until July 19.

The destruction of thirty-four nestlings and twenty-two eggs in the vicinity of Forest Glen brook may have been instrumental in reducing the number of kingfishers, yet the shooting of fifty-six, mostly juveniles, on this brook during the month of August indicates that, to be effective, a much wider destruction of nests would be necessary.

Shooting kingfishers is probably one of the least effective methods of keeping them under control. It requires a daily patrol of the waters and is most effective when two shooters are employed to drive the birds within range of the guns. Moreover the kingfisher is both a small target and a fairly difficult one when in full flight.

At Forest Glen brook brush blinds were used to conceal the shooter near favourite perches and a number of birds were shot by this means.

Mergansers

We believe that the most effective way to keep down the merganser population on a stream is to kill off the breeding females early in the season before they have had a chance to bring forth a brood of young. This method was employed at Forest Glen brook and throughout the season no young ducks were seen on the brook.

The smolt rack erected near the mouth of the stream undoubtedly would have discouraged any duck with her brood of young which attempted to ascend the stream from the river. The killing of all females found along the adjacent parts of the river further decreased the possibility of any brood migrating into the brook.

In 1936 we were, on several occasions, successful in securing a number of young from broods which we encountered along the river and this past summer Mr. Lawrence Bennet a warden at Northeast Margaree, shot both old and young mergansers and kept them well under control in the area of his patrol.

When the females have succeeded in bringing forth their young we have found that entire broods may be captured by using a net. The net which we have used was hung especially for the purpose of netting young mergansers. This net is about three inch stretched mesh, one hundred and fifteen feet long, six feet deep and is sixed to double, right and left-twist ropes. It has neither sinkers or floats. In operation it is stretched across a rapids and is kept open by sticks about four feet long attached to the top and bottom ropes.

When it is fastened securely across the stream with the sticks holding the top line about fifteen inches above the surface,

the broods of young mergansers are driven down stream into the net. When they strike the net they thrust their heads or if they are small enough the most of their bodies through the meshes and are quickly drowned. In all cases where we have used this method the female accompanying the brood has turned back when she encountered the net. As she turned to fly back she was easily shot by the attendant who was concealed near the net.

This past summer (1937) two female mergansers were found feeding along the river at Long Intervale about three miles below Forest Glen brook. On July 13, the assistance of three of the local wardens was secured and a drive was made toward the net which was set on a rapids at the lower end of the ducks' feeding range. Seventeen young were taken in the net and the two females accompanying them were shot when they turned back from the net.

Other fish-eating birds

Kingfishers and mergansers are the principal fish-eating birds found along the upper Margaree but late in the season it is visited by a few great blue herons. This heron is a wary bird and generally it is only by careful stalking that one can get within effective shotgun range. They could probably be killed more easily with a small-bore rifle equipped with telescopic sights. Eight herons were shot along Forest Glen brook during August and September and all of these were juveniles. American bitterns and ospreys are rare visitors along the salmon waters and it would be only in exceptional cases that control would be necessary.

Food of the birds shot on Forest Glen brook

Kingfishers

Of the seventy-three kingfishers which were shot on Forest Glen brook, sixty-two were secured for stomach analyses. Eleven were lost in thick vegetation or were carried away by the current before they could be secured.

The stomachs examined contained a total of four hundred and thirty-seven fish and one shrew (Sorex palustris). The fish consisted of three hundred salmon, one hundred and twenty-nine trout and eight sticklebacks. The salmon were made up of 257 fry, 37 yearlings and 6 two-year parr. The trout consisted of 117 fry and 12 one year or older. The sticklebacks were represented in their stomach contents by an occasional spine or dermal plate. Since there are no sticklebacks in Forest Glen brook the birds which contained these must have been recent arrivals on the brook.

We endeavoured to shoot the kingfishers as soon as possible after their arrival on the brook so that their feeding would have a minimum effect on the fish population. Nevertheless certain individuals were able to evade the gunners for several days. This was particularly true for mature birds. While these birds were on the stream they dropped pellets beneath perches which we had arranged to facilitate the collection of pellets. Thirty-two pellets were collected along the brook and these contained the remains of young salmon as follows: 81 fry, 28 yearlings and 19 two-year fish. There were also the remains of 26 trout fry and 41 older trout and six sticklebacks.

Mergansers

Only two of the mergansers shot on Forest Glen brook were secured for stomach analyses. One was empty and the other a female M. americanus contained 2 smolts, 1 two-year parr and 2 yearlings.

Great blue herons

After the arrival of the herons in the spring they are found in the vicinity of Margaree harbour. There is a heronry situated to the south of the harbour and the breeding birds feed and secure food for their young largely from the estuarial waters. Near Lake Ainalie there is another heronry and the birds from this may be found feeding around the lake also in some of the tributary streams and the upper part of the Southwest Margaree. We know of no heronry on the upper Northeast Margaree and herons are seldom seen there until after the breeding season.

The first young birds arrived at Forest Glen brook early in August but only a few were observed there throughout the season. Those which were seen feeding along the upper part of the river were generally in the small brooks, backwaters, side runs or in flood plain pools. They were seldom seen in the main parts of the river or in the larger tributaries. The character of the food in their stomachs reflected the types of the habitats they frequented. Eight juveniles were shot in the valley of Forest Glen brook and one along the river.

These nine birds contained 3 salmon parr, 9 trout, 6 sticklebacks 40 insects and 3 mammals. The salmon consisted of 2 yearling parr and one fry. The recognizable trout remains contained eight trout from four to eight inches in length and one fry. The sticklebacks ranged from 18 to 33 mm. In only one of the stomachs was the insect content sufficient to be significant.

That stomach contained 27 locusts (Melanoplus femur-rubrum). Other insects found in the stomachs were species of beetles and dragonflies. Two voles (Microtus pennsylvanicus) and one shrew (Sorex cinereus) were found in the stomachs.

In view of the scarcity of these birds along the brook and their feeding habits they may be considered of minor importance in their relation to the salmon of this stream.

American bitterns

The distribution of the American bittern along the Margaree is confined largely to the estuarial part of the stream and to the watershed of the southwest branch. In those parts there are many quiet waters surrounded by a heavy growth of vegetation making the kind of habitat frequented by the bittern.

Along the Northeast Margaree with its bare flood-swept beaches and scant marginal vegetation these birds are rare. Throughout the summer at Forest Glen brook only a single bittern, a juvenile, was seen. This bird was shot while feeding along the brook about two miles above the mouth of the stream. It contained two yearling salmon parr which it had recently caught.

This record may be regarded as unusual, since during our three summers on the Margaree this was the only time that a bittern was seen in the immediate vicinity of a habitat of the type occupied by the parr.

Ospreys

Ospreys are rare throughout the Margaree system. A pair nested near the harbour in 1936 and the old birds caught fish in the estuary. In 1937 only three ospreys were seen in the vicinity of Forest Glen brook and only one of these entered the valley of the brook. This bird was shot and its stomach was

found to be empty.

Since the young salmon are too small to be caught by these birds and the adult salmon are too large, they can scarcely be considered as enemies of the salmon. They might take an occasional trout, but owing to the scarcity of these birds the damage done by them could not be great.

Food analyses

Detailed tables of the analyses of the food of all the birds shot both on Forest Glen brook and the neighbouring parts of the river are given in tables accompanying this report.

Fish Destroyed by Fish-eating Birds on Forest Glen Brook in 1937

The fish remains found in both kingfisher stomachs and pellets consisted of 428 salmon, 196 trout and 14 sticklebacks making a total of 638 fish. The fact that many of the kingfishers which were shot on Forest Glen brook a few minutes after their arrival had in their stomachs fish which were mostly digested or even well-formed pellets indicates that such fish were not taken from the brook. Moreover, the presence of stickleback remains in these birds shows that they had fed recently elsewhere than on the brook.

However, certain birds particularly mature birds which were very wary managed to live along the brook for ^a week or more before they were shot. The most of the kingfishers which were shot were juveniles and were taken shortly after their arrival on the brook. Other birds which visited the brook and fed there for a short time went back to the river after being shot at but undoubtedly some of these were killed on subsequent visits.

From the nature of our data it is evident that any estimation of the fish destroyed by birds on Forest Glen brook

during the summer of 1937 must be inaccurate. Yet the number may be safely stated within rather wide limits. If we allow that each kingfisher which was killed had fed along the stream for a minimum of half a day at the rate of thirty fish per day this would give a total of 1080 fish. Two days for each kingfisher would be a liberal maximum and at the same rate of feeding would give a total of 4320 fish.

Mergansers and herons were kept in much better check than the kingfishers and at the most could have taken only a few hundred fish. Thus it seems safe to assume that the number of salmon and trout taken from Forest Glen brook during the summer of 1937 was between one and five thousand fish. According to our general analyses of the food of these birds the captured fish would be 70% salmon and 30% trout.

Food Analyses of Great Blue Herons Shot at Forest Glen Brook

1937

Date	Place	Salmon	Trout	Stickle-backs	Insects	Mammals
Aug. 16	F.G.br.	2	1		1 coleop.	
Aug. 20	F.G.br. side run		2			2 voles.
Aug. 25	Alder br.				4 locusts	
Aug. 28	F.G.br. on arrival	1	4	6	1 odonata 1 coleop.	
Aug. 31	F.G.br.				1 locust 1 coleop.	
Aug. 31	F.G.br. side run				1 gerrid. 1 notanecta	
Sep. 6	F.G.br. on arrival		1		1 locust 1 coleop.	
Sep. 10	F.G.br. side pool				27 locusts	
Sep. 22	Margaree Mc.Kenzies brook		1	2		1 shrew

Kingfisher Nestlings, Upper Margaree River, 1937.

Card KN	Date	Place	Bird Weight OZ.	Salmon Length	Age	Trout No.	Length	Remarks
1	June 26	Ingraham bridge	2 1/2	7.5	1			All of this brood contain much chitin and many fish eyes.
2	"	"	"	7	1			
3	"	"	"	-	-	-	-	
4	"	"	"	-	-	-	-	
5	"	"	"	-	-	-	-	
6	"	"	"	7	1	1	6	
7	18	Black Rook	2 1/6			1	7.5	As above
8	"	"	"	7.5	1	-	-	
9	"	"	"	7	1	-	-	
10	"	"	"	-	-	-	-	
11	"	"	"	10	2	-	-	
12	"	"	"	-	-	1	10	
13	25	Ross Brook	3 6/7			1	10.2	As above
14	"	"	"	7	1	-	-	
15	"	"	"	8.5	1	-	-	
16	"	"	"	6,8	1,1	-	-	
17	"	"	"	7,6,6	1,1,1	-	-	
18	"	"	"	6,7	1,1	-	-	
19	"	"	"	7	1	-	-	
20	"	"	3 5/7	7	1	-	-	As above
21	"	"	"	11,13	2,2	1	12	
22	"	"	"	8	1	1	11.5	
23	"	"	"	8	1	-	-	
24	"	"	"	13,7	2,1	-	-	
25	"	"	"	8,8	1,1	-	-	
26	"	"	"	11,7	2,1	-	-	
27	July 5	Marsh pool	5 6/7	9	1	-	-	
28	"	"	"	-	-	-	-	
29	"	"	"	12	2	-	-	
30	"	"	"	12.7	2.1	-	-	
31	"	"	"	-	2	-	-	
32	"	"	"	11	2	-	-	
33	"	"	"	9.5	1	-	-	

Kingfisher pellets collected along Forest Glen Brook 1937.

F.G. No.	Date	Place	Salmon		Trout		Other	Remarks	
			fry	yls. 2-yr.	fry	older fish			
34	May 10	S. fld.				1		older 4½"	
1	15	"		1		1		smolt? 2½" trout	
2	15	"	2			2		trout 4" ea.	
3	15	"				2		" 5" ea.	
4	15	"		1		2		" 3-5"	
11	14	"	1	2		2		" 3-4"	
12	14	"	1			1		trout 3½"	
13	14	"				2		trout 4-4½"	
14	14	"		2		4		" 3½-4-4-4-4-4"	
15	14	"				1		4½" trout 4½"	
16	14	"	1			1		trout 5½"	
5	15	"	1			1		trout 2"	
6	15	"	1			2		trout 5-2"	
7	15	"	1			2		trout 4-2½"	
9	15	"	1			1		trout 2½"	
8	15	"				3		trout 5-4-3"	
10	15	"				2		trout 4½-3"	
21	19	"	1			2		trout 3-3½"	
17	30	"	2	1		1		trout 2"	
18	June 12	"	2				1G.scul.		
19	12	"	1			1		trout 3½"	
20	12	"		1					
22	July 26	"		1					
23	26	"		1		1		trout 4"	
24	26	"	1	3		2		trout 3" ea.	
32	26	"	5	7		3	1G.scul.	trout 4-4-2" G.scul spine only 2 pellets	
31	Aug. 15	"	15	3		2			
33	19	"	18	3		2		pellets unbroken	
25	27	"	4			5	1	trout 4"	
26	30	Near mouth	5			3			
27	30	"	7	1		2			
28	30	"	7			6		2G.scul	
29	30	"		1				1G.scul	
30	30	"	25			6		1G.scul	
Totals			81	28	19	26	41	6	

Kingfisher Stomach Analyses, Forest Glen Brook, 1937.

F.G. No.	Date	Place	Salmon		Trout		Other fish	Remarks	
			fry	yls	2-yr.	fry			older
36	June 12	S. fld.			1				
97	July 19	S. fld.		3	1		1		
52	Aug. 3	S. fld.	2	1					
53	" 3	"	3						
54	" 3	"	2	1		1	1		
42	" 10	Hd. Is.	15						
39	" 12	S. fld.	1	1		1			
75	" 16	Is. P.	4	2	1			2 G. acul.	
80	" 19	S. fld.	11	1					
81	" 19	"		3					
82	" 19	"	1	1					
83	" 19	"			1				
76	" 20	Is "	17			2			
77	" 20	"	2			3			
78	" 20	"							
79	" 20	"	1					Fish remains	
72	" 24	S. fld.						1 mammal	
								Sorex palustris	
68	" 25	S. fld.	12	1		5			
66	" 27	"	2	1	1				
67	" 27	"	3			2			
			76	15	5	14	2	2	1 mammal
Above Turner br.									
95	Sept 6	"	5			6			
90	" "	"	1			1	1		6" trout
56	Aug. 2	"	16	1		15	1		
35	" "	"							Remains of Salmonid.
			22	1		22	2		

S. fld. - Stewart field.
Hd. Is. - Head of Island.
Is. P. - Island Pool

Kingfisher Stomach Analyses, Forest Glen Brook 1937.

F.G. No.	Date	Place	Salmon			Trout		Other Fish	Remarks
			fry	yls.	2-yr	fry	older		
49	Aug. 5	bridge	4	-	-	4			
44	"	b. trap	1	-	-	1			
43	"	"	2	1					
48	" 6	bridge	7			7			
47	"	"	1	1					
46	"	"	6			3			
45	"	"	5			1			
51	" 7	"	13		1	2			
50	"	"	4			1			
40	" 9	"	3			2			
41	" 11	Sec. R	10			2			
38	" 13	bridge	1						
37	" 13	"	2					1 G. aculeatus	
85	" 18	Sec. R.		1				1 "	
84	" 19	bridge	1			1			
74	" 22	"	5	1		3			
73	" 22	"				7			
71	" 25	"	10			1			
70	" 25	"	8			8			
69	" 25	Rock P.	13			4			
65	" 26	Bridge		1			2	1 G. aculeatus	
64	" 27	"	2			1			
63	" 28	"	5						
62	" 28	"	12			2	1		
61	" 28	"	3			1		1 G. aculeatus	
60	" 28	"	1			1			
59	" 28	"	3			2		1 "	
57	" 29	Rock P.	2			1		Bullet through stomach Salmonid bones	
58	" 30	bridge							
94	Sept 2	Sec. R.	3			8	1		
88	" 3	"						1 Fish eye only	
96	" 4	Bridge	9	2		1			
87	" 5	Rock P	2			4		1 G. Acul.	
89	" 6	bridge	9	1		1			
91	" 7	Sec. R.	1	1		1	1		
86	" 14	"	11	1		5			
93	" 20	"		1			1		
92	" 22	bridge				2	1		
			159	11	1	81	8	6	

Miscellaneous Mergansers Shot on the Upper Margaree, 1937

Duck	Date	Place	Food		Other Food
			Salmon	Trout	
Duckling					1 spider
weight 2 oz.	June 11	below gorge	3 (yls.)		(ephemerid rem.)
"	"	"	3 (yls.)		
"	"	"	2 (yls.)		1 pipalid
♀ with the ducklings	"	"	3 (yls.)	1	
Immature M. americanus	July 27	Long Intervale	9 (yls.)		
"	"	"	6 (2-yr.)		
"	"	"	4 (yls.)		
"	"	"	4 (2-yr.)		
"	"	"	9 (yls.)		
M. serrator	"	"	4 (2-yr.)		
"	"	"	1 (2-yr.)		
Juvenile M. americanus	Sept. 9	Above First Fork	2 (10-7 cm.)	4 (6-13 cm.)	
			54	5	

Kingfish Pellet Analyses, Upper Margaree River, 1937.

Date	Place	Salmon	Trout	Remarks
May 15	Big Pool	-	3	1 G. sculestus
" 23	"	-	1	
" 23	"	-	1	
June 13	"	1	-	Smolt
" 13	"	-	2	
" 13	"	1	2	Smolt
July 27	Long Intervale	5	-	
" 27	" "	2	-	2 pellets mixed
Aug. 11	Marsh pool	1	-	1 G. sculestus
" 11	"	19	4	3 G. sculestus (3 pellets) Salmon-10 fry, 8 yls. 1 2-yr.
" 30	Below Forest	-	2	
" 30	Glen Br.	1	-	
Sept 22	Break-water	-	-	
" 22	pool	2	-	
" 22	"	-	3	2 pellets mixed
18 pellets		32	18	5 G. sculestus

Stomach Analyses of Mergansers taken in bird net at Long Intervale
Margaree river, July 13, 1937.

SALMON			TROUT		Other food, remarks
Fry	Yls.	2-year	number	lengths	
Young birds taken in nest					
-	-	1	1	3 1/2"	
-	1	-	1	3 1/2"	
-	1	-	-	-	Rootlets
1	2	-	-	-	
-	1	-	1	3"	1 vert. col. sucker fry?
-	1	-	1	3"	veg. frags wood.
-	-	-	-	-	Salmonid bones
-	2	-	-	-	grass stems
-	2	-	-	-	
-	1	-	-	-	
-	1	-	1	2 1/2"	
-	1	-	-	-	
-	-	-	-	-	veg. frags wood.
-	-	-	-	-	veg. frags straws
-	1	-	-	-	
-	-	-	-	-	Salmonid remains
-	1	-	-	-	veg. frags.
Adults shot					
-	1	1	-	-	
-	3	1	-	-	
1	19	3	5		

Appendix.

A collection of Mayflies (Ephemeroptera) was made from the stream on June 14/37. These have been examined by Dr. F. P. Ide of the University of Toronto. The following species and genera were identified. *Ephemerella invaria*, *E. surivilli*, *E. cornuta*, *E. bicolor*, *Stenonema vicarins*, *Iron fragilis*, *Pseudocloeon Carolinae*, *Baetis vagans*, other genera recognized but too immature for species identification were - *Elestarus*, *Amoletus*, *Siphonurus*, *Heptagenia*.

Regarding the collection Dr. Ide states:

" The presence of *Ephemerella surivilli* would seem to indicate that the stream never reaches a temperature much above 20° C. There is an absence of species which in Ontario are found in the lower reaches of the rivers which warm up to temperatures of 29 or 30°C. The fauna is similar to but not identical with that which has been collected from the upper reaches of trout streams in Ontario."

ATLANTIC SALMON AND TROUT INVESTIGATIONS

1938

Report No. XV. Salmon landed at Margaree Harbour and Grand Etang in 1938.

By

P. F. Elson

Salmon taken by set nets, 1938.

Grand Etang Salmon Union.

Joseph P. Desveaux 25N

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 9	8	121
11	10	125
14	5	61
16	8	85
18	8	83
21	7	96
25	9	100
28	5	55
July 1	4	43
2	11	106
4	15	198
5	14	208
7	4	64
8	20	210
9	10	153
11	7	75
12	16	215
13	14	154
14	7	83
15	8	100
16	8	86
18	8	101
19	3	50
21	7	103
23	4	67
25	9	105
26	9	124
29	4	54
30	7	97
	<u>249</u>	<u>3122</u>

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
Forward	249	3122
Aug. 1	12	160
2	11	169
3	13	182
4	27	336
6	8	123
8	8	100
10	7	84
11	13	137
12	6	93
15	11	156
16	10	152
	<u>375</u>	<u>4814</u>

21N

Date	Salmon	Lb.
June 10	1	10
13	4	45
14	1	22
15	2	31
18	5	57
20	1	17
22	4	46
24	1	11
25	1	9
27	1	8
July 1	1	12
4	3	36
5	2	39
6	2	29
8	5	55
13	4	54
17	1	11
18	1	20
23	1	9
26	1	14
30	1	20
Aug. 2	3	36
3	4	53
4	1	11
	<u>51</u>	<u>609</u>

Paul LeBlanc

20N

Date	Salmon	Lb.
June 9	1	18
10	1	15
11	1	10
13	5	62
15	2	31
17	1	10
21	2	21
25	2	18
July 2	1	9
4	2	19
5	5	58
6	1	18
7	1	10
8	3	33
9	1	10
11	5	53
12	3	46
13	3	30
14	3	41
16	2	17
18	2	21
19	1	14
21	1	10
25	2	21
26	1	11
	<u>52</u>	<u>606</u>

John J. Cormier 16N

Date	Salmon	Lb.
June 10	6	68
11	4	65
13	3	43
14	1	9
16	3	38
17	7	87
18	5	80
20	3	35
21	5	80
23	1	18
24	5	65
25	10	122
27	3	33
28	2	24
30	2	15
July 1	6	81
2	10	142
5	11	154
6	15	173
7	11	128
8	7	101
9	9	109

John J. Cormier, continued:

Date	Salmon	Lb.	Date	Salmon	Lb.
July 11	1	10	Aug. 12	2	27
12	1	9	15	2	18
13	12	156	16	7	95
14	4	43			
15	1	17		248	3260
16	4	52			
18	7	88			
20	3	28			
21	1	18			
22	6	70			
23	1	13			
25	3	55			
26	5	73			
27	1	14			
30	2	31			
Aug. 1	15	236			
2	11	129			
3	13	160			
4	8	103			
5	2	29			
8	2	33			
9	5	83			

Gabriel Au Coin 24N

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 17	3	28
18	3	39
20	5	65
22	1	7
27	1	12
29	1	20
July 1	1	8
2	1	9
5	1	8
6	1	9
7	1	12
9	8	113
11	2	17
12	3	39
18	1	16
20	1	13
22	2	35
23	1	9
25	3	32
27	2	32
28	1	9
29	1	13
30	5	69
Aug. 1	7	117
2	8	115
3	2	20
4	1	11
5	3	40
9	3	32
10	2	24
11	3	27
	<u>78</u>	<u>1010</u>

Joseph Doucet 18N

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 7	1	10
9	2	20
10	1	7
11	2	26
13	5	59
16	1	7
18	1	10
20	2	25
21	2	26
22	3	39
23	2	27

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 24	3	29
25	2	27
27	2	23
28	2	25
30	4	56
July 1	3	32
2	9	150
4	4	50
5	3	44
6	1	17
7	4	65
8	3	39
9	1	10
11	7	71
12	5	77
13	5	55
16	9	131
18	2	21
21	1	10
22	3	46
23	5	64
25	8	115
26	9	122
27	2	18
29	2	41
30	3	50
Aug. 1	7	82
2	1	13
3	10	143
4	4	39
5	1	18
6	2	40
8	1	10
9	1	13
10	2	28
11	3	37
15	3	49
16	4	63
	<u>163</u>	<u>2179</u>

Fred L. Cormier 22, 23 N

<u>Date</u>	<u>Selmon</u>	<u>Lb.</u>
June 14	2	30
18	1	9
20	3	29
22	2	28
24	1	9
25	1	10
27	1	11
July 1	3	32
2	1	16
4	1	8
5	1	8
6	1	12
8	3	32
9	1	10
15	5	51
16	2	26
18	1	20
19	1	12
21	3	49
22	1	8
25	2	31
26	1	8
28	1	14
30	2	20
Aug 1	1	17
2	2	22
3	9	109
4	1	9
	<u>54</u>	<u>640</u>

Arsene Au Coin 19 N

June 8	3	29
9	1	8
10	2	23
13	6	66
15	1	11
16	2	23
20	2	27
21	2	27
22	1	10
23	2	22
24	5	56
25	1	14
27	2	30
28	1	13
29	1	26
30	1	15

<u>Date</u>	<u>Selmon</u>	<u>Lb.</u>
July 2	2	20
4	3	37
5	5	74
6	4	49
7	1	9
8	2	23
9	5	60
11	6	63
12	1	16
15	3	35
16	5	61
18	2	17
19	1	12
25	9	117
26	7	101
27	2	27
28	3	32
30	4	55
Aug. 1	6	97
2	4	47
3	10	143
4	1	22
5	1	12
6	1	8
	<u>121</u>	<u>1537</u>

Emilien P. Au Coin 17 N

June 16	3	30
20	3	33
21	1	10
July 2	1	16
4	3	27
6	1	9
8	4	49
9	3	27
11	6	78
13	1	15
23	2	24
25	3	54
26	1	8
Aug. 1	7	104
2	2	21
3	3	32
4	1	8
8	2	31
	<u>47</u>	<u>574</u>

Martin Doucet 15N

Philip Desveaux 9, 10 N

Date	Salmon	Lb.
June 10	1	11
11	5	57
13	5	75
14	5	60
15	5	53
16	2	21
17	3	46
18	2	29
20	5	51
21	8	107
22	8	95
23	3	52
24	2	18
25	5	50
27	2	17
28	4	44
29	2	20
30	1	10
July 1	10	122
2	16	231
4	3	39
6	1	20
7	4	46
8	3	29
9	10	115
11	6	67
12	2	24
13	13	159
15	13	181
16	8	96
18	7	77
19	5	50
25	11	123
26	4	58
27	2	20
30	6	60
Aug. 1	11	149
2	8	128
3	8	92
4	6	61
5	3	27
6	1	10
8	4	58
11	1	10
12	4	41
15	1	10
	<u>239</u>	<u>2899</u>

Date	Salmon	Lb.	Date	Salmon	Lb.
June 10	1	15	Aug. 11	6	66
11	2	39	12	3	41
13	4	48	15	3	42
14	3	30	16	5	92
15	3	30		—	—
16	1	10		—	—
18	1	16		284	3746
20	3	49		—	—
21	6	63		—	—
23	1	10		—	—
24	6	82		—	—
25	10	122		—	—
28	4	36		—	—
30	1	20		—	—
July 1	7	103		—	—
2	5	56		—	—
4	9	111		—	—
5	8	88		—	—
7	5	64		—	—
8	6	58		—	—
9	8	85		—	—
11	8	88		—	—
12	8	105		—	—
13	2	52		—	—
14	3	52		—	—
15	5	77		—	—
16	6	76		—	—
18	1	9		—	—
19	1	8		—	—
21	4	75		—	—
22	2	27		—	—
23	9	120		—	—
25	15	219		—	—
26	5	68		—	—
27	6	77		—	—
29	3	39		—	—
30	20	300		—	—
Aug. 1	19	252		—	—
2	20	312		—	—
3	16	181		—	—
4	1	15		—	—
5	7	85		—	—
6	2	29		—	—
8	7	94		—	—
9	1	12		—	—
10	2	18		—	—

Dominic LeBlanc 11, 12 N

Jim Arsensult 7,8 N

Date	Salmon	Lb.
June 8	2	31
9	1	10
10	4	47
11	2	18
13	2	28
14	1	9
15	3	32
16	2	27 $\frac{1}{2}$
18	5	63
20	3	34
21	3	39
22	6	83
25	2	19
28	1	9
July 1	6	93
2	3	27 $\frac{1}{2}$
4	6	104
5	12	148
6	4	45
7	3	42
8	7	75
9	6	84
11	2	25
12	1	10 $\frac{1}{2}$
13	3	38
14	11	145
15	3	35
16	7	86
18	4	57
19	3	40
21	3	43
22	3	40
25	9	134
26	4	60
29	1	13 $\frac{1}{2}$
30	16	210
Aug. 1	28	381
2	11	149
3	(15	(202
	(11	(136
4	6	74
5	3	50
8	7	91
9	2	20
	<u>237</u>	<u>3108</u>

Date	Salmon	Lb.	Date	Salmon	Lb.
June 9	1	21	Aug. 10	1	10
10	1	9	11	3	36
11	1	10	12	1	11
13	1	10	13	1	10
14	1	17	16	3	35
15	1	17			
16	6	78		176	2245
17	1	12			
20	5	74			
22	3	31			
23	1	16			
25	2	33			
28	1	10 $\frac{1}{2}$			
29	3	47			
30	3	36			
July 1	3	49			
4	9	88			
5	3	30			
6	6	73			
8	2	26			
9	1	13			
11	10	114 $\frac{1}{2}$			
12	1	11			
13	6	77 $\frac{1}{2}$			
14	10	106			
15	6)	74			
	1)	11			
16	1	9 $\frac{1}{2}$			
18	6	73			
21	3	42 $\frac{1}{2}$			
23	4	67			
25	3	47			
26	3	39			
27	2	19			
29	2	23			
30	5	52			
Aug. 1	20	262			
2	4	53			
3	19	286			
4	2	26			
5	1	10 $\frac{1}{2}$			
8	2	30			
9	1	9			

Thomas Au Coin 4-6 N

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 8	7	84
9	8	98
10	4	58
11	6	54
13	11	138
14	5	57
15	4	40
16	2	24
17	1	22
18	7	101
20	14	185
21	5	46½
22	4	43
23	4	47
24	9	126
25	5	61
27	1	12
28	1	21½
30	3	48
July 1	10	145
2	1	16
4	19	243
5	21	265
6	11	120
7	2	32
8	10	123
9	28	322
11	11	123
12	4	55
13	6	85
14	5	70
15	15	192
16	12	132½
18	12	181
19	1	19
20	2	21
21	10	130
22	3	42
23	22	279
25	16	227
26	4	60
27	4	44½
28	1	17
29	3	53
30	19	239
Aug. 1	49	691
2	63	837
3	42	516
4	6	92
5	9	103½
6	7	97
8	13	151
9	16	182

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
Aug. 10	2	38
11	2	35
12	11	135
13	8	106
15	24	228½
	<u>605</u>	<u>7814</u>

John L. McKinnon 1 S

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 20	2	20
22	3	51
23	2	31
27	4	56
29	1	13½
July 1	1	8½
5	3	37
6	3	31
9	1	10
11	1	13
12	5	73
13	3	39½
14	1	13
15	2	23
18	1	10
26	7	88
Aug. 1	18	252
2	8	114
3	15	197½
4	4	49
8	3	38
9	12	159
11	3	35
12	1	7½
13	5	45
15	5	79½
	<u>114</u>	<u>1494</u>

Angus McKinnon 3, 4 S

Allan K. McLean 6, 9 S

Date	Salmon	Lb.
June 21	1	10
27	2	19
29	1	19
30	1	9
July 1	3	43
2	2	29
4	3	26
5	10	97
6	2	28
7	6	61
8	2	20
12	1	8½
Aug. 8	1)	20
	5)	37½
9	1	10
11	4	44½
12	1	7
13	5	65
15	2	38
16	1	9
	<u>54</u>	<u>600½</u>

Date	Salmon	Lb.
June 16	6	69
18	6	65
20	3	34
21	1	9
22	1	10
28	1	10½
July 1	5	57
2	1	8
4	1	8½
5	5	43
6	6	83
8	20	200
9	4	45
11	1	11
12	2	20
16	2	31
18	1	10½
23	2	25
Aug. 6	2	18½
89	11	9½
11	1	10
	<u>73</u>	<u>787½</u>

Dan McKinnon 25, 26 S

Haverstock McLean 7, 8, S

Date	Salmon	Lb.
June 16	1	12
18	4	47
20	10	113
21	6	49
24	5	54
25	7	88
27	2	34
30	5	65
July 2	4	48
4	3	30½
6	1	10
9	2	29
16	6	88
18	1	12½
20	7	111
	<u>64</u>	<u>790</u>

Date	Salmon	Lb.
June 4	4	34
9	6	80
10	2	24
13	4	61
16	6	61
18	3	43
20	5	63
21	3	30
22	5	78
24	1	12½
25	2	28
28	2	25
July 1	10	115
2	2	20
4	5	65
6	8	98½
8	5	56
9	9	107
11	2	19
12	8	102
13	7	100
14	4	66
23	2	36
26	1	14½

Haverstock McLean 7, 8, s (cont'd.)

Aug. 1	15	223
2	(13)	(156)
	(3)	(47½)
3	7	86
5	4	51
8	3	51
9	9	121
10	6	77
12	9	105
13	1	20
16	1	24
	<u>177</u>	<u>2297</u>

From books of W. S. Laurence, Margaree Harbour.

Chas. D. McLean

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 20	1	9
21	1	10
22	1	9
24	3	35
25	3	28
30	2	17
July 1	1	17
2	1	17
5	2	26
6	2	27
9	9	113
11	2	29
13	3	30
15	2	26½
16	5	49
18	1	8
20	2	18
25	9	123½
Aug. 1	16	200
2	17	225
3	13	158
4	3	44
8	6	88
9	3	31
10	1	17
15	1	10
16	9	124
	<u>119</u>	<u>1491</u>

Angus C. McKinnon

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 21	1	8
24	1	9
25	1	15½
28	1	10½
30	3	25½
July 1	1	10
2	1	9½
Aug. 6	1	12
8	4	41
	<u>14</u>	<u>151</u>

Simon H. McKinnon 16 S

Date	Salmon	Lb.
June 24	2	18
25	4	42
27	1	8½
28	1	10½
29	3	40
30	6	69
July 1	1	8
4	5	55
5	2	26
6	1	9½
9	1	10
Aug. 3	5	71
	<u>32</u>	<u>367½</u>

Howard McKay and Co. 203

June 25	1	16
29	2	29
30	3	32½
July 1	5	55
4	5	69½
5	1	10
6	12	171
9	11	130
12	4	44
	<u>44</u>	<u>557</u>

John A. McKinnon 193

June 16	1	9
18	4	39
21	1	8½
22	1	8
24	2	31
25	2	35½
27	1	11
30	2	40
July 1	2	20
2	2	26
6	2	32
Aug. 1	10	153
	<u>30</u>	<u>413</u>

Tom White and Co. 293
(Formerly John McFarlane)

Date	Salmon	Lb.
June 16	3	41
18	11	133
21	7	83
24	20	293
27	10	112½
30	10	150
July 2	4	62½
9	6	75
13	4	54
16	26	306
18	1	16
21	7	99
23	7	145
28	1	10
	<u>117</u>	<u>1582</u>

Neil Day and Co. 153

June 16	1	21
20	3	29½
21	3	42
22	10	110
24	1	20
28	1	10
30	1	12
July 1	2	27
5	1	13
6	4	53
13	2	29
14	1	9
23	1	11
25	4	63
	<u>35</u>	<u>449½</u>

Sylvestre LeBlanc 1 N

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 10	5	59
11	2	27
13	4	41
14	1	10
15	2	21
16	1	9½
17	2	25
18	1	21
20	4	55
21	6	68½
22	1	11
25	1	21
July 4	2	30
5	5	75½
6	5	71
7	3	48½
8	3	53
9	5	52
11	6	85
13	1	11½
14	2	22½
15	2	30
16	3	33
18	3	51
20	2	29½
21	5	80
22	2	30½
23	6	87
25	10	147
26	4	51
Aug. 1	6	86
2	11	159
3	8	83½
4	9	94
5	5	52
8	2	22
9	1	13
11	6	104
12	1	10
	<u>148</u>	<u>1970½</u>

(3rd berth N. of Harbour)
Francis LeBlanc 3N

<u>Date</u>	<u>Salmon</u>	<u>Lb.</u>
June 13	4	48
15	1	9½
16	1	18
17	3	27½
20	1	10
21	1	9
23	2	41½
27	1	17
July 2	1	10½
4	2	33
5	1	10½
6	4	54
7	1	9
8	6	88½
9	6	78
11	7	91
12	4	49½
14	4	62
15	5	56
16	8	108½
18	2	26½
19	1	12
21	4	51
22	2	35½
23	2	33
25	7	107
26	3	38
27	3	39½
Aug. 1	4	55
2	12	172
3	16	212
4	4	57
5	3	42
8	3	45
9	1	16
11	5	66
12	1	9
13	2	18
	<u>138</u>	<u>1861½</u>

ATLANTIC SALMON AND TROUT INVESTIGATIONS

1938

Report No. XVI. The weight-length relationship of the
Atlantic salmon.

By W. S. Hoar

(Manuscript revised and published)

ATLANTIC SALMON AND TROUT INVESTIGATIONS.

1938

Report No. XVII. Notes on Salmon in Canada, and particularly in Nova Scotia.

By J. B. Porter

Salmon originally occurred on the Atlantic Coast of North America and in the rivers flowing into the sea from the mouth of the Hudson at New York - to central or probably Northern Labrador. Also in the whole of the Gulf of St. Lawrence and its shore rivers, and in the St. Lawrence River up to Lake Ontario and in its lower tributaries. They may even have extended along the Atlantic coast several hundred miles south-west of New York, although the old records for this last extension of range are meagre and not altogether trustworthy.

They have disappeared totally from the more southern United States coastal waters, and at present are only found as rarities of no angling importance in all waters on the United States coast up to within a few miles of the Canada-United States boundary in lat. 45, long. 67W, a distance of over 500 miles measured in a straight line. They have also disappeared totally from the St. Lawrence River and its tributaries to roughly 100 miles below Quebec where the river merges with the Gulf proper.

In all Canadian waters on the Atlantic coast and the Gulf of St. Lawrence proper, salmon are still found in considerable numbers although greatly reduced, except at the extreme north-east and north where trustworthy records are not kept, and the coast is too difficult of access to make nets and river angling of any

present importance. This useful salmon coast of Canada may be ^{miles} said roughly to be 1800 miles on the Atlantic sea-board and 2500[^] on Gulf of St. Lawrence waters, both measurements omitting to take any account of all but very major irregularities of coast line.

It is, of course, too soon to get figures for 1938 for much of this long coast line and, in fact, some 1937 reports are not yet available; but we have ample evidence that there has been an erratic, but general, falling off in catches of both nets and rods for a great many years, and that this shortage has been much greater than normal in 1937 and even worse in 1938, and that the present situation is causing great anxiety to all concerned.

Fortunately, through the kindness of officials of the Fishery Department of that province, I have been able to get approximate advanced figures for Nova Scotia, and these figures confirm the above general statement. The southern half of the Atlantic coast of Nova Scotia shows a very great loss in 1937 as compared even with the more gradual decrease of previous years, and 1938 is even worse for this southern 500 miles of seaboard. This especially heavy loss becomes less as we go north, and due to exceptionally heavy late summer rains and a longer open season, Cape Breton island in the north-east of Nova Scotia actually shows a slight gain in 1938, but incomplete and less detailed figures from Newfoundland show that the general falling off already reported, seems to have continued on to the north as far as my records go.

How far the above losses are due to general Atlantic conditions affecting European fisheries also, is not quite clear as Nova Scotia also suffered from a serious local shortage of summer rainfall from 1931 to 1936, and many of the smaller streams were inaccessible to spawning fish for these years with a resultant shortage, or even absence of parr and smolts in 1935 and 1936. It is hard to say how much harm these dry summers effected in the larger rivers, but they were completely disastrous to many small streams as can be indicated by my own experience for the two small rivers which are close to my own country place in the extreme north-east of the Nova Scotia mainland. These yielded only one fish each in 1937 and 1938, whereas we used to get 20 or 30 salmon and grilse from them yearly to our own rods only in the years before 1930.

At the close of this report, I shall append a statement of reported catches for groups of rivers and nets on different sections of the Nova Scotia coast, but I may here give a brief comparison of Nova Scotia with Scotland from the salmon fisher's point of view.

Scotland is a little larger than Nova Scotia, 29750 square miles to 21500, but is much shorter and about twice as wide. The Atlantic coast of each is very deeply indented by fiords, but whereas the largest Scottish rivers flow eastward into the North sea and the Atlantic rivers are short and steep, in Nova Scotia the longer rivers and most of the short ones also flow into the Atlantic.

Both countries are mountainous in a geological sense, but Nova Scotia being very much older geologically and subjected to general glacial action for untold ages, has been worn down until even the highest points are only between 1000 and 1500 feet above sea level, and the peaks and glens are far less rugged. Both countries have great numbers of lakes, large and small, and many of them are accessible to salmon.

Climatically Scotland has a decidedly greater rainfall, and is, so far as my information goes, much less liable to long continued summer droughts, and last, but not least Nova Scotia is ice-bound from end to end for many months each winter and the streams are not free for running fish before late April, or even early June in the north-eastern part, and the salmon season is therefore very short, particularly in dry summers. Finally, whereas salmon are completely free to travel around Scotland between the Atlantic and the North Sea coasts, in Nova Scotian waters fish can only get to the south-west coast by the Bay of Fundy with its enormous tides, and to the north-west coast by the somewhat round-about course of the entrance to the Gulf of St. Lawrence where they have the choice of going to the many and much larger rivers of the whole 2000 mile coast line of the Gulf of St. Lawrence, rather than to the fewer and much smaller streams of the west coast of Nova Scotia.

NOVA SCOTIA - SALMON AND GRILSE

The following figures have been tabulated and rearranged from advanced information furnished in MSS. by the Dominion Department of Fisheries.

It should be noted that the net catches are very nearly complete and the percentages of loss or gain are calculated for 1935 and 1936 averaged against 1937 and 1938. The rod catches are made up for only typical rivers of the larger size on which fairly exact reports are available, and gains or losses for 1938 only are calculated on the 1936-7 averages. If rod returns were available for all rivers the totals for a normal year would be at least 15%, and probably 20% or more above the totals of the 20 rivers herein reported - but would not be over 12 to 15 percent for the particular years covered, as the smaller streams were suffering from a depletion of fish following the drought of 1932-5.

Coastal Divisions	1935	1936	1937	1938	Recent gain or loss
Atlantic coast S.W.					
Nova Scotia - Main					
<u>Nets</u> -whole coast	678	789	608	444	Loss of 40%
<u>RGDS</u> -6 large rivers only.	640	1396	1422	608	Loss of 56%
Bay of Fundy coast S.W.					
Nova Scotia - Main					
<u>Nets</u> -whole coast	532	528	349	285	Loss of 41%
<u>RGDS</u> -4 larger rivers only.	-	353	305	216	Loss of 35%
Atlantic coast N. E.					
Nova Scotia - Main					
<u>Nets</u> -whole coast	1472	1133	970	1062	Loss of 23%
<u>RGDS</u> - 10 larger rivers only	-	2146	1993	1320	Loss of 36%
Gulf St. Lawrence coast N.W.					
Nova Scotia - Main					
<u>Nets</u> -whole coast	1139	1549	1449	725	Loss of 20%
<u>RGDS</u> - no large salmon rivers proper	-	-	-	-	-
Atlantic coast N. S. W. and E.					
Coast of Cape Breton Island					
<u>Nets</u> -whole coast	1237	901	931	1408	Gain of 10%
<u>RGDS</u> -2 large rivers only (see Note A)		163	349	390	Gain of 50%
Gulf of St. Lawrence coast N.S.					
Cape Breton Island					
<u>Nets</u> - whole coast	972	1119	731	1048	Loss of 15%
<u>RGDS</u> - 1 river only (see Note A)	-	286	312	488	Gain of 50%
Total - Nova Scotia coast					
<u>Nets</u> -	6030	6019	4638	4975	Loss of 20%
<u>RGDS</u> - large rivers only	-	4344	4381	3022	Loss of 31%

NOTE A. The Cape Bretons have a much longer late summer season, and thus get the benefit of late summer rains, and they usually have their best fishing after other rivers are closed.

NOTE B. The Atlantic coast, and to a less extent the whole coast, has a very large numbers of quite small rivers each yielding a few fish under ordinary conditions, but few or none in dry summers. These little rivers are not included in the reports of the Department. There are also quite a number of medium sized rivers, reports on which when available have all been excluded as they also have been abnormally affected by recent exceptionally dry years. Under normal conditions (prior to 1935) these omitted rivers would probably add 1700^c to the total of the 20 larger rivers counted, or say a total of nearly 8000 for the province.

NOTE:

Since writing this little paper, I have received trustworthy information from an official source that my statement at the bottom of paragraph three, page 2 - which was specifically based on very incomplete and informal reports of local character - is not borne out for the net catch of Newfoundland as a whole, and that the total catch of the nets for the whole coast of Newfoundland has actually increased during the last two years.

We thus have the very significant fact that while there has been a loss averaging approximately 40% for the southern 550 miles of the Nova Scotia coast, this loss has decreased in the north-eastern part of Nova Scotia mainland, has changed to a small gain in Cape Breton and has become a definite increase in Newfoundland. This shift which is clearly independent of local factors is undoubtedly due to some cause, or causes affecting the North Atlantic, and is presumably related to the changes which have been reported for British water.

ATLANTIC SALMON INVESTIGATIONS

1938

Report No. XVIII. A hydrograph for measuring fluctuations in water level.

By H. M. Rogers

For the purpose of obtaining a continuous record of the fluctuations in the surface level of water, several instruments have been constructed, of very simple design, yet meeting the demands of both efficiency and economy. Where fluctuations are of a tidal nature, as in estuaries or on the coast, the instrument if placed at such locations could well be termed a "tide gauge" or "tide indicator, but this term naturally does not apply when the instrument is used for purposes of measuring fluctuations in lakes or rivers, where the variations may be due to rainfall or freshets. For this reason it is better called a "water level indicator" or, more simply a "hydrograph".

In principle, a pencil, actuated by a float through a suitable reduction gearing, traces a curve on a drum turning at the rate of about one revolution per week. The drum is motivated by an eight day clock. An ordinary lead pencil is used, pen and ink being found impractical, due to minute fluctuations caused by wave action. Pen is used if machine is not measuring tidal fluctuations. If a constant fluctuation, ink tends to blot.

Regular hydrographs sold commercially are apt to be expensive, ranging from about \$150 to \$300 for the simpler types, and for the more complex machines, prices run into four figures. The machines to be described cost approximately \$60 yet we feel that they should

serve just as efficiently for ordinary purposes as some of the more expensive types.

In their construction, use was made for the sake of economy of certain items manufactured by Meccano, Ltd. (such as gear wheels for the reduction assembly). Specially made gears are costly, whereas the Meccano gears, in addition to being inexpensive and if necessary easily replaced, are accurate, and the various ratios, 1:2, 1:3, etc., are interchangeable, almost any ratio desired being obtainable through suitable combinations.

Construction.

Base. All mechanism is mounted on a cast iron base 11" x 6 $\frac{1}{2}$ " x $\frac{3}{4}$ ", the underside being ribbed to lessen weight and yet preserve strength. A $\frac{3}{8}$ inch round rod of monel metal and a square $\frac{3}{4}$ inch brass pillar are screwed into the base, the former carrying the revolving drum, the latter the pencil holder which is free to move up and down. The clock and gear-box are also screwed to the base.

Clock. The clocks are the type used by the Cambridge Instruments Ltd. of London in their construction of thermographs, and were obtained from Instruments, Ltd. in Toronto. They are very compact, and all vital mechanism is enclosed within a circular case, the driving spindle making one complete revolution in seven days. The spindle was screwed into the iron case, and thus being held secure, the body of the clock was caused to turn. A large gear was fitted over the circular body of the clock. Twenty four hour clocks are also obtainable.

Drum. This part of the instrument revolves on a $\frac{3}{8}$ inch monel metal rod, 11 inches in height. It is $9\frac{1}{2}$ inches long by 5 inches outside diameter, made from light gauge 5 inch brass tubing. The ends are of sheet brass $\frac{3}{32}$ inches thick, turned down so that $\frac{2}{32}$ is inserted into the end of the tube, the other $\frac{1}{32}$, in the top plate, being flush with the edge of the drum, in the bottom plate, extending beyond the edge of the drum so as to form a $\frac{1}{32}$ inch ledge for supporting the paper blank. Paper is held in place on the drum by a metal strip in the conventional manner.

Gearing of clock and drum. The clock could not be placed within the drum due to its direction of revolution, an external connection by means of gears thus being necessary. Two gear wheels, 4" and $4\frac{1}{2}$ " in diameter respectively, of 28 pitch, were cut from $\frac{1}{2}$ " brass plate, the smaller being fitted snugly around the body of the clock, the other fitting loosely over the rod carrying the drum. The drum is separated from this larger gear by a $\frac{3}{8}$ " bakelite disk, $3\frac{1}{2}$ " in diam., which acts both as a clutch and as a means of raising the drum sufficiently high above the gears to allow the free passage past the junction of the gears of the tip of the metal strip holding the paper blank in place. The connection between drum and source of power is thus only a frictional one, permitting the drum to be set in any desired position for accurate timing.

Since the clock revolves once in 7 days, the ratio of the gears 4 to $4\frac{1}{2}$, or 8 to 9, calls for one revolution of the drum in $7\frac{7}{8}$ days, thus making an allowance for the metal strip holding the paper, beside allowing a few hours leeway. The circumference of the drum is $15\frac{1}{2}$ " , which thus allows 2 inches for each 24 hours.

The pencil mechanism. This consists of an ordinary lead pencil held in a spring clip, the latter attached to a strip of spring brass. This in turn is screwed to a brass weight moving vertically on a brass guide pillar, $\frac{3}{4}$ " square, and 12" high above the base. The sliding weight is suspended by chain running from the gear box over a sprocket wheel at the top of the pillar. A light brass weight on the other end of the chain keeps it taut.

The float. This part of the apparatus consists of a copper cylinder with rounded ends, 10 inches long, 5 inches in diameter, and of a $\frac{3}{4}$ " displacement. It rides low in the water facilitating partial elimination of wave action effects.

The gear-box consists of three pieces of $\frac{1}{2}$ " brass plate screwed together, forming a base and two sides. Within the box, a reduction gearing of 6:1 is used as standard (3:1 x 2:1) with another 3:1 provided to give an 18:1 ratio if desired. On the spindle receiving the chain from the float are three sizes of sprocket wheels, $\frac{3}{4}$ ", $1\frac{1}{2}$ " and 3" having with one another the relation 1:2:4. The sprocket wheel over which the chain actuating the pencil mechanism runs is the $\frac{1}{2}$ " size. If the float chain is on the $\frac{3}{4}$ " sprocket, then using the 6:1 ratio within the gear-box, a 6:1 reduction is obtained. With the $1\frac{1}{2}$ " and 3" sprockets, the reductions are 12:1 and 24:1 respectively. If the 18:1 reduction provided within the box is utilized, then the ratios are tripled and are 18:1, 36:1 and 72:1. Since the drum will take an 8 inch curve comfortably, the fluctuations in water level that will give an 8 inch curve with these various ratios are 4, 8, 12, 16, 24, and 48 feet.

Almost any other ratio desired can be secured by suitable arrangement of the gears.

Chain. The float is connected to the gear-box by chain of 6 links to the inch supplied by Meccano Ltd. It is cadmium plated. It passes over one of the sprocket wheels, and is held taut by a brass weight at the end.

Description of parts in Figure

- A. Clock with gear wheel surrounding its cylindrical body.
- B. Side view of clock with gear removed.
- C. Clock gear wheel.
- D. Gear supporting drum with which the clock gear meshes.
- E. Top view of gear box and assembled gears.
- F., G., and H. The three sizes of sprocket wheels.
- G. The $1\frac{1}{2}$ " size is used also at the top of the brass pillar.
- H. The $\frac{1}{2}$ " size is used both on the spindle receiving chain from the float and on the spindle controlling movement of the pencil mechanism.
- I. Gear wheels used in the gear box, two 3:1 ratios and one 2:1.
- J. Side view of gear box.
- K. Brass weight on the end of the float chain.
- L. Pencil clips.
- M. Sliding brass weight to which is screwed the spring brass strip carrying the pencil clips.
- N. Light brass weight to keep the pencil mechanism chain taut. (should be approximately equal to M in weight).
- O. Bakelite disk.
- P. Brass collars used in the gear box assembly (Meccano Ltd.).
- Q. Brass collar on which rests the large gear wheel D.

